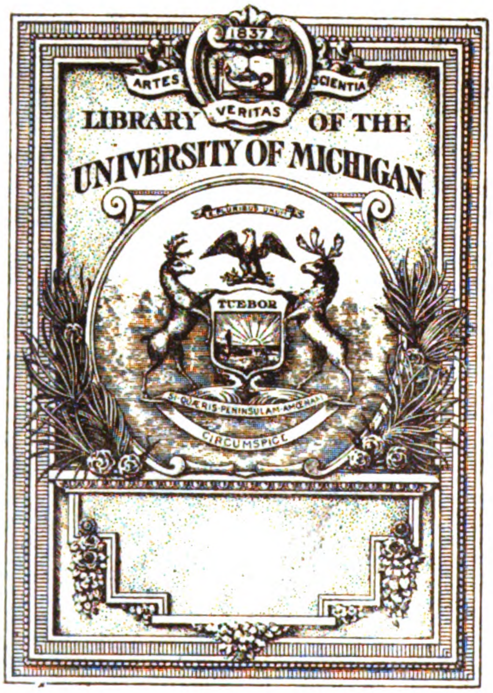
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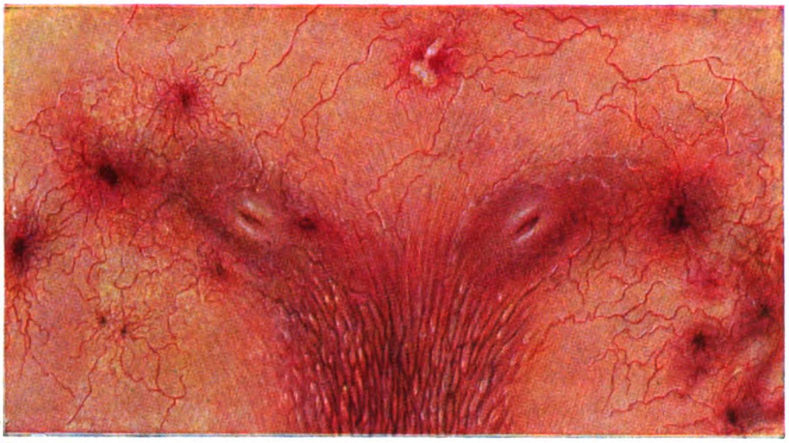

Subacute Cystitis (see page 217).

FRY

Showing characteristic patchy appearance of the bladder, each patch being an intense dull red in color surrounded by a varying zone of hyperemic vessels which seem to branch out from the central stem. Also the occasional areas of less well defined hyperemia. The lips of the ureter openings are swollen; the trigone is lumpy and somewhat swollen.

PRACTICAL CYSTOSCOPY

AND THE

DIAGNOSIS OF SURGICAL DISEASES OF THE KIDNEYS AND URINARY BLADDER

BY

PAUL M. PILCHER, A.M., M.D.

CONSULTING SURGEON TO THE EASTERN LONG ISLAND HOSPITAL; LATE SURGEON TO THE GERMAN, SENEY AND SAMARITAN HOSPITALS OF BROOKLYN, N. Y.; ASSOCIATE SURGEON TO ST. JOHN'S HOSPITAL OF BROOKLYN; ATTENDING CYSTOSCOPIST TO THE JEWISH HOSPITAL OF BROOKLYN

SECOND EDITION, THOROUGHLY REVISED

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To the Memory of

Elijah Homes Pilcher

A SCHOLAR, AVID OF ALL LEARNING; A PIONEER LABORER IN THE DEVELOPMENT OF A NEW STATE; A MINISTER OF THE GOSPEL, WHOLLY DEVOTED TO THE GOOD OF HIS FELLOW MEN

THIS BOOK IS DEDICATED
IN GRATEFUL REMEMBRANCE OF THE MANY PATIENT HOURS
GIVEN BY HIM, WHEN LAID ASIDE BY THE INFIRMITIES OF AGE, TO THE EARLY EDUCATION
OF HIS GRANDSON,

Paul M. Pilcher

PREFACE TO THE SECOND EDITION

ALTHOUGH the basic principles of cystoscopy have changed very little during the past four years, the writer, in presenting the second edition of his book, has found it necessary to rewrite entirely a number of chapters, and has added some new sections.

Pyelography has come to occupy a distinct position of its own. An entire new section has been devoted to this subject, detailing the indications for its use, its technic, the diagnostic value of radiographic studies of the ureter and kidney, and the accidents and dangers of pyelography. Appended to this is an Atlas of Pyelography taken from the library of Dr. William F. Braasch, of the Mayo Clinic. Since writing this chapter a new silver suspension, called Argentide, has been introduced by Dr. Edward L. Young, of Boston. This mixture seems to be safe for use in pyelography and gives equally good shadows. However, the author's experience with it is not as yet sufficient to justify recommending it.

The chapter on Disease of the Prostate and the chapter on the Functional Activity of the Kidneys have been entirely rewritten, bringing the subjects up to date.

Under the chapter on Pathologic Conditions of the Ureter the technic of the Harris Method of Diagnosis has been included.

Deductive diagnosis, based upon the combined evidence of the cystoscope, the radiograph, and our improved laboratory methods, has come to occupy a position of increasing importance. This is brought out especially in the chapter on Renal Calculus and is applied in other chapters as well.

The last part of the book deals with the therapeutic uses of the cystoscope and has been rewritten and very greatly extended. This reconstruction has been called for, especially, because of the improvement in our operating cystoscopes and the introduction of the high frequency spark in the treatment of lesions of the bladder.

Section I takes up the general therapeutic uses of the cystoscope.

Section II deals with the special therapeutic uses of the cystoscope. In this section the various surgical procedures carried on by the use of special instruments is considered. Here are detailed the newer types of operating cystoscope and their application indicated.

Following this are chapters devoted to a consideration of the high frequency current as used in the bladder, including a discussion of the equipment necessary and giving the technic in detail of using the current. The operator is instructed in the application of the spark, the interval between the treatments, the evidence of cure, the difficulties encountered, the indications and contraindications for the use of the current. The chapter takes up the use of the spark in the treatment of new-growths in the bladder, as an agent in the control of hemorrhage, in the treatment of chronic ulceration, in the treatment of masses of tissue which cause obstruction, as an aid in the treatment of calculous disease of the ureter, and its application in prostatic disease.

An appendix is added which shows some useful special cystoscopes of American manufacture.

In revising this work the author has felt that it was better not to overload its pages with illustrations of all the newer types of cystoscopes. Very few changes have been made in the general principles already in use, and the newer instruments have been illustrated only in connection with their application to special diseases.

The writer wishes to express his thanks especially to Dr. Hugh Cabot, of Boston, and to Dr. Lewis W. Bremmerman, of Chicago, who carefully read the text of the first edition of this work, and made many suggestions which have been of much assistance to the author in bringing the work up to date. In a number of places throughout the work it will be observed that the notes of these men have been added to the text.

PAUL M. PILCHER.

145 GATES AVENUE, BROOKLYN, N. Y.
June, 1915.

PREFACE TO THE FIRST EDITION

DURING the past ten years the study of diseases of the kidneys, ureters, and urinary bladder has been greatly stimulated by the development of newer methods of diagnosis. The Röntgen rays, the cystoscope, the endoscope, the ureteral catheter, the segregator, and the research laboratories each have contributed to the advance which has been made. Of these, the cystoscope and the ureteral catheter undoubtedly are the most important; at the same time the other diagnostic aids should not be neglected.

The cystoscope is an instrument of precision. It has revealed the living pathology of diseases of the urinary tract, and has made clear many previously obscure conditions. In many instances it has replaced exploratory incisions, and, indeed, it often affords a far more exhaustive means of diagnosis than any other hitherto devised.

The indications for the use of the cystoscope are becoming more generally known, and the ease and safety with which a simple cystoscopic examination of the bladder can be made have led to its early employment in appropriate cases.

In the present volume the writer has endeavored to state fairly the indications for cystoscopy, and to outline its technic in the minutest detail, describing the instruments used and how to use them. Theoretical possibilities have been purposely omitted, and only the practical side of the subject has been presented. The difficulties met with are described, and the methods for overcoming them are given.

To realize the highest benefit from the use of the cystoscope one must have had considerable clinical experience. A student may see the interior of the bladder and correctly interpret the picture, detailing the lesion and defining its extent. He can tell us the condition of each kidney, both pathologic and physiologic. The experienced surgeon can take these findings and, provided he knows how to interpret them, can convert the knowledge to his own uses.

The diagnosis of diseases of the bladder, prostate, ureters, and kidneys has been taken up in separate chapters. The clinical picture is given, and the writer has tried to show the relation of cystoscopy to the various pathologic states. This part of the work has been written especially for the clinician and surgeon, so that he may apply the findings of the cystoscopist to the relief of his patient. In each section the symptoms, cystoscopic findings, direct and differential diagnosis, and the indications for treatment have been given. In the last section of the book the therapeutic uses of the cystoscope are considered, and in this part the general practitioner will find reviewed those conditions in which treatment through the cystoscope has supplanted the older methods.

The teachings contained in this book are based upon the writer's personal observations, which have been undoubtedly influenced by the teachings and writings of other authors, but nothing has been put down here which has not been observed or tested by the writer.

Most of the illustrations have been drawn from life by Miss Eleanora Fry, who has made a study of cystoscopy in order to aid in this work. The care and patience she has shown in reproducing what she has seen have contributed to the value of the book.

The writer has had the privilege of studying under Nitze and Casper in Berlin, and Von Frisch in Vienna; and this preface would not be complete without grateful mention of their names.

The work of Albarran, Kapsammer, and Brenner in Europe; Fenwick in England; and F. Tilden Brown, Bransford Lewis, Braasch, Ayres, Keyes, Young, Buerger, Willy Meyer, Otis, and Bierhoff have all added valuable contributions to the advance of cystoscopy.

PAUL M. PILCHER.

145 GATES AVENUE, BROOKLYN, N. Y.

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PRACTICAL CYSTOSCOPY

INTRODUCTION

THE INDICATIONS FOR THE USE OF THE CYSTOSCOPE

THE different tissues and organs composing the genito-urinary system are so numerous, and the diseases to which they are subject are so diverse, that a diagnosis based upon symptom-groups, in combination with the urinary findings alone, may be misleading. There are certain symptom-groups of definite clinical significance which are so characteristic that when they are present we are able to differentiate without instrumental examination the probable extent and location of the disease. When we consider, however, that a diseased condition of one portion of the genito-urinary tract is frequently the starting-point of an extensive infection of the whole apparatus, the determination of the exact location and the extent of the primary pathologic condition becomes more difficult. Since all of the various component parts of the system are connected by tubes of varying sizes, and all excretions and secretions must pass from the kidney and ureters through the bladder, and from the seminal vesicles and prostate and bladder through the urethra, a simple examination of the urine will not always enable us to determine with accuracy the source of the disease. In all cases, however, the usual preliminary steps in the establishment of a diagnosis should not be omitted.

In the investigation of disturbances of the genitourinary organs a detailed history of the case is first necessary—the *anamnesis*. Next, a careful chemical and microscopic examination of the urine should be made; attention should then be directed particularly to:

1. Abnormalities and disturbances in the mechanics of urination.
2. Changes in the character and ingredients of the urine.
3. The presence or absence of pain; its occurrence independent of, at the beginning, during, or at the end of micturition.
4. The presence or absence of pus or bacteria in the urine.
5. The presence or absence of blood in the urine. The duration of hematuria, when present, circumstances, occurrences during rest or after exertion, and relation to micturition.

A thorough physical examination should follow.

Urethral Catheterism.—Next in importance comes urethral catheterism. By passing the catheter we are able to ascertain the amount and constituents of the residual urine; through the catheter the bladder may be irrigated, the bladder capacity ascertained, and the degree of irritability of the bladder determined. By the passing of sounds the presence of a stricture or other obstruction may be determined, the presence of a stone in the bladder may sometimes be ascertained, and the urethra may be dilated as a preliminary to the introduction of the cystoscope, if further investigation is called for.

Contraindications to Urethral Instrumentation.—Certain conditions may contraindicate urethral catheterism. These apply equally to the sound and to the cystoscope and should not be disregarded. As a rule, acute inflammation of the urethra and bladder contraindicates instrumental examination. This includes acute urethritis, acute prostatitis, and acute cystitis, especially that arising from gonorrheal infections. Instrumental injury of the parts, under such conditions, is often followed by an extension of an inflammation which previously had been purely local. Some writers state that instrumentation of the urethra is contraindicated in tuberculosis of the prostate. In my own experience the involvement of the prostate has in no way contraindicated examination other than in the minor degree of causing pain, which the introduction of the instrument may produce.

In determining diseased conditions of the seminal vesicles and prostate one more step, the rectal examination, is necessary.

We seldom find indications for cystoscopy in children, as the affections of the bladder and kidneys in these patients are not numerous; but, in young adults, and in fact in all patients over eight years of age, a cystoscopic examination can be made, if such further examination is indicated.

SPECIAL INDICATIONS

Disturbances in the Mechanics of Urination.—*Increased frequency of urination* is the most common symptom of urinary disease, particularly of disease of the bladder. It may be due simply to increased acidity of the urine or to the presence of irritating substances in the urine. Urinary frequency may be due to swelling of the trigone without any other disease of the bladder; most often, however, it is due either to inflammation of the bladder or its trigone, or to the presence of a foreign body in the bladder. The condition, however, is often a reflex symptom associated with pyelitis, renal stone, or other foreign body descending the ureter. It occurs also with tuberculosis of the kidney and ureter, and, in fact, with many inflammatory affections of the kidney or ureter.

Diabetes mellitus, diabetes insipidus, chronic interstitial nephritis, and urina spastica, are examples of conditions in which the quantity of the urine is increased, with resulting frequency of urination. In neurosis of the bladder the frequency of micturition is most marked during the day; in hypertrophy of the prostate there is increased frequency, especially at night, whereas in cases of vesical calculi the urgency is most marked, as a rule, only when the patient is active.

Many of the above-mentioned conditions are accompanied by characteristic clinical symptoms, and a diagnosis is easily established. It often happens, however, that a doubt is cast upon the diagnosis because the disease does not yield to appropriate treatment. Under such circumstances cystoscopy is indicated because the extent and character of the inflammation of the bladder, abnormalities of the trigone, the presence of foreign bodies or tumors in the bladder, the existence of extra-vesical tumors pressing upon the sensitive trigone, and disease of the ureter and kidney, can all be determined with greater accuracy by the cystoscope than by any other known means, not excepting exploratory operation.

Retention of urine may be due:

1. To obstructions of the urethra from stricture, foreign bodies, hypertrophy of the prostate, or the formation of a prostatic bar.
2. To central nervous causes located in the spinal cord.
3. To defects in the bladder musculature by which its extrusive power is lessened.

If the obstruction is situated in the urethra anterior to the prostate, its cause is easily ascertained. If in the prostate or prostatic urethra, cystoscopy is indicated before operation in order to determine the exact nature of the obstructing mass. If of central nervous origin, there are characteristic appearances which will be revealed by visual inspection of the bladder.

Incontinence, difficult, painful or slow urination, and sudden stoppage of the stream, may all call for cystoscopy before the exact etiology can be determined. Incontinence, as a general rule, is due to paralysis or relaxation of the sphincter, to overdistention of the bladder, to an increased reflex excitability, or to spasmodic contraction of the muscular walls of the bladder. In order to differentiate between these it is sometimes, but not always, necessary to see the interior of the bladder.

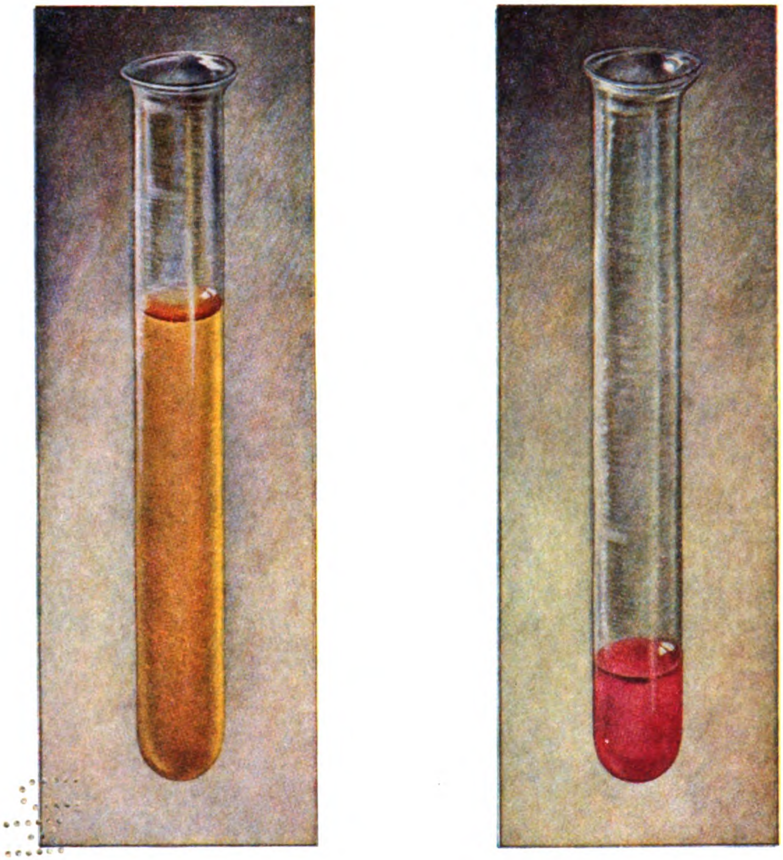
Indications derived from the Chemical, Physical, and Microscopic Examination of the Urine.—Pyuria, hematuria, or other abnormal conditions of the urine, without definite localizing signs, are the symptoms which most frequently call for cystoscopic examination. Many rules have been formulated by careful microscopists to guide the physician in determining the source of urinary abnormalities, but when checked up by exact cystoscopic exploration, the interpretations may be found to have been misleading. For example, we read: "The largest amounts of pus come from an inflamed bladder, or from a rupture of an abscess in the urinary tract." "Urine containing pus from the kidney, or from an outside source, is usually acid, and from the bladder, more or less strongly alkaline." (Butler.) The writer, however, after a careful study of over 400 cases of pyuria and hematuria, each of which has been subjected to careful microscopic and cystoscopic examination, finds himself unable, from a simple examination of the urine, containing pus or blood, to say definitely what its source may be.

Pyuria.—When pus originates in the urethra, prostate, or seminal vesicles, its source is not difficult to establish. When an acute cystitis follows a posterior urethritis, abscess of the prostate, instrumentation, or wound of the bladder, the symptom of pyuria is not difficult to explain. When, however, a pyuria persists, despite appropriate treatment, or is accompanied by definite renal symptoms, cystoscopy is called for to determine its source. Pyuria occasioned by the presence of a calculus in the bladder or a new-growth of the bladder, may be the only abnormal symptom in these diseases. Its source often remains obscure until a cystoscopic examination reveals the presence of a stone or growth.

If suppurative disease of one kidney has been found, it is equally important to discover the presence and condition of the second kidney before operation is undertaken.

The great importance of early diagnosis in tuberculosis of the kidney is well known. It has been stated that when pyuria occurs in young persons, without known cause, and

PLATE II



A B

Hematuria.

A, Test-tube showing only a slight amount of blood present. It is impossible to say whether this blood comes from the kidney, bladder, or urethra without exploration of the bladder. B, Showing a larger amount of blood and a more even distribution of the blood-cells in the urine. The origin of the blood is obscure until cystoscopic examination is made. In the case from which this drawing was made the source of the blood was in the bladder.

does not yield readily to proper treatment by drugs, irrigation, or instillations of silver nitrate, tuberculosis should be suspected. We know also that in about 90 per cent. of the cases the disease originates in one kidney and for a long period of time the second kidney remains free from disease. There is only one way in which the diagnosis can be definitely made and that is by cystoscopy and ureter catheterism.

Hematuria.—The symptom of blood in the urine is not sufficiently distinctive to enable a positive diagnosis of its source to be made without taking into account the possible diseases in which such an event may take place. Its occurrence alone, without other urinary symptoms, in so many cases makes the diagnosis especially difficult. Strangely enough the same lesions may give rise to symptomless hematuria, and to one associated with pain, pyuria, etc. The hemorrhage may take place from the urethra, bladder, or kidney, and unless there is some definite symptom to point to the source of the bleeding, such as an injury, a blow, or some acute localized disease, it is not possible to tell with accuracy the source of the hemorrhage.

Before the cystoscope came into use there were certain rules laid down for determining the source of the hematuria. These referred to the color of the urine, the time of appearance of the blood during urination, and lastly the shape of the clot. These symptoms are so often misleading, however, and the importance of determining the source of the hemorrhage is so great that, if there is no acute inflammation present and the hemorrhage is not from some apparent injury or coexisting disease, such as malaria, scarlet fever, or any of the severe septic conditions, or following severe burns or the ingestion of irritating drugs, such as turpentine or cantharides, a cystoscopic examination is indicated, and, as a rule, the source of the hemorrhage can be determined, although the exact cause of the same may still be obscure. In certain cases of malignant disease of the kidney, tubercular ulcer in the pelvis of the kidney, renal varix, or large renal stone, there may be no symptoms other than the bleeding, to differentiate the condition. In such a case the clinical history must be carefully considered and the x-ray may be employed.

Bacteriuria; Pneumaturia; Crystals; etc.—The source of bacteriuria, pneumaturia, large groups of crystals, epithelial cells, casts, and parasites, may also be determined by cystoscopy and ureteral catheterism.

Albumin, when present in the urine as discharged from the bladder, may not be a true index of the amount coming directly from the kidney. A collection directly from the ureter may show a surprisingly small amount of albumin in the urine. This I found of importance in determining the degree of toxemia of pregnancy in a recent case.

Indications Derived from Other Symptoms.—*Pain*, with or without urinary symptoms referred to some portion of the genito-urinary tract, frequently calls for cystoscopic exploration. If the pain is of renal origin without any abnormalities in the urine, its seat in the kidney may be determined by artificial distention of the renal pelvis. If associated with pyuria or hematuria the source of this can also be determined. If referred to the bladder, visual inspection will demonstrate any ulcer, inflammation, or foreign body which may be causing it.

Pyrexia, with Urinary Symptoms.—It is not very difficult to exclude the prostate and bladder as the source of pyrexia with urinary symptoms. In the more severe forms of cystitis there is usually a moderate rise of temperature, but this subsides quickly under treatment. A sudden chill, with marked pyrexia, with or without pain in the renal region, accompanied by increased frequency of urination and pus in the urine, naturally directs attention to the kidney as the source of the trouble. Pain and tenderness in the renal region often are misleading symptoms, and those who have depended upon them entirely for a diagnosis have often been in error. One must not rely entirely upon the cystoscopic examination, for a number of severe septic conditions are accompanied by pyuria, the pyuria being merely an expression of the general septicemia and not a cause of the pyrexia. In general, however, it may be said that the ureter catheter will show whether or not the kidney is the source of the pyrexia.

In many cases, a simple cystoscopic examination of the bladder will show which side is diseased by observing the condition of the ureter opening and character of the urinary efflux.

Derangement of the Functional Activity of the Kidney.—Herein lies one of the strongest and most valuable indications for cystoscopy, for by its aid we are able to forestall a disastrous operative result and thereby gain greater confidence in the surgical attack upon the kidney. A recent case affords a good example of this:

CASE.—An elderly lady, past sixty years of age, had been operated upon some nine years before for fibroid tumor of the uterus. Within the past few months she had been failing in health, complaining of some pain in the right renal region, but there had been no urinary symptoms until shortly before her reference to the writer; then a sudden hematuria appeared. This took place without undue exercise, and was not accompanied by any other symptom. It lasted about twenty-four hours, after which the urine entirely cleared. A second hemorrhage occurred at the end of another week. When the patient was examined, it was found that her right kidney was considerably enlarged, and was the site of a tumor which was diagnosed as a hypernephroma. The question then arose as to the propriety of removing this affected kidney. The urines were collected separately from the two sides. After an injection of phenolsulphonephthalein, no reaction took place in the urine from the left kidney for fourteen minutes, when, under normal circumstances, this appears in from seven to twelve minutes. The urine from the right kidney showed a still greater interval. During the next twenty-four hours only seventeen ounces of urine were passed with a low percentage of urea.

A few days later a second cystoscopic examination was made. After injecting indigo-carmin only a slight trace of color appeared in the urine from either kidney in forty-five minutes. It was, therefore, determined that the function of the left kidney was not sufficiently good to permit the removal of its mate. Operation was refused. The patient died four weeks later in uremic coma.

It is necessary to collect the urine separately from each kidney for carrying out this test. The methods for accomplishing this and the tests to be used will be described in detail later.

As an Aid to Surgical Work.—We are able by the aid of cystoscopy to determine the presence or absence of a second kidney; to locate fistulous openings from the bladder or ureter; to determine the feasibility of surgical intervention, and to aid in pelvic operations by placing a catheter in the ureter as a guide.

CYSTOSCOPY VERSUS EXPLORATORY OPERATION

In regard to the relative advantages of cystoscopy and exploratory suprapubic section of the bladder, it may be said that the former method of diagnosis is more exact because we are able to examine the bladder with the walls stretched out and the ureter openings in plain view, while in the latter case with an incision in the anterior wall of the bladder, the walls are collapsed and hang in folds obscuring all but the grosser details; the ureter openings are difficult to see, and are often covered with blood from the wound. Two examples will suffice.

CASE 1.—A young man was referred to the writer complaining of increased frequency of urination and hematuria; the blood had been present continuously for three months. There were no other symptoms. The urinary findings, aside from the presence of blood and a moderate number of pus-cells, were negative.

A cystoscopic examination showed on the anterior wall of the bladder a distinct tumefaction with infiltration of the mucous membrane and a few bleeding-points. The surrounding area did not dilate or stretch as completely as the rest of the bladder.

Later a suprapubic section was made and upon opening the bladder in the median line, over the site of the supposed tumor, no growth was discoverable. The writer decided, however, to remove that portion of the bladder wall which the cystoscope had shown to be diseased. Under the microscope the tissue removed was found to be the seat of tubercular disease, infiltrating the tissues; there were also intramuscular hemorrhages. If the operator had depended entirely upon the operative findings he would not have removed the diseased area.

Case 2.—An even more striking example than Case 1 was that reported by Ware,* of New York. The patient suffered from painful and frequent urination. A careful cystoscopic examination revealed tubercle bacilli and leukocytes coming from one ureter. The ureter opening itself was ulcerated and deformed. An operation was advised and the kidney exposed. The organ was bisected, opening freely the pelvis and calices of the kidney. After a thorough examination of the kidney no disease was found. On attempting to close the incision in the kidney some injury to the vessels took place and an uncontrollable hemorrhage demanded the removal of the organ. After the kidney was removed it was again examined and the pelvis showed a small tubercular ulceration about the size of a five-cent piece.

These two cases illustrate the fact that cystoscopy may be a more accurate method than exploratory incision for determining the source and extent of genito-urinary disease.

These in general are the indications for cystoscopy, and, although many objections have been raised by those who are ignorant of its value, still our actual experience with its employment has led us to depend upon it for more accurate information in general than can be obtained even by exploratory operation.

The technic of cystoscopy is very simple in the majority of cases. It involves, however, a thorough knowledge of the anatomy of the urethra and the bladder, and a full appreciation of aseptic surgical technic. The use of the ureter catheter is, however, much more complicated and should not be attempted without considerable previous practice in simple cystoscopy.

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* *Annals of Surgery*, vol. 1, p. 879.

PART I

THE TECHNIC OF CYSTOSCOPY

SECTION I

THE CYSTOSCOPE

CHAPTER I

TYPES AND CONSTRUCTION OF EUROPEAN AND AMERICAN CYSTOSCOPES

A CYSTOSCOPE is an instrument for inspecting the interior of the urinary bladder. In order to accomplish this satisfactorily, the bladder must be distended with either air or a clear non-irritating fluid. The interior of the viscus must be clearly illuminated and a telescopic tube fitted with lenses introduced through the urethra or some other opening into the bladder. If simple endoscopic tubes are used, no lens system is employed.

There are three distinct types of cystoscopes at present in use:

1. The simple examining cystoscope.
2. The ureter catheterizing cystoscope.
3. The operating cystoscope.

The most useful of the simple examining cystoscopes, of European manufacture, is the *Nitze indirect examining cystoscope.* In appearance the instrument resembles a metal catheter with a short angulated beak. It consists of a shaft, a beak, and a funnel-shaped ocular portion. The shaft contains the optical apparatus at the distal end of which there appears a window in which a prism is fixed. This receives the bladder picture and transmits it through a series of lenses to the eye of the observer.

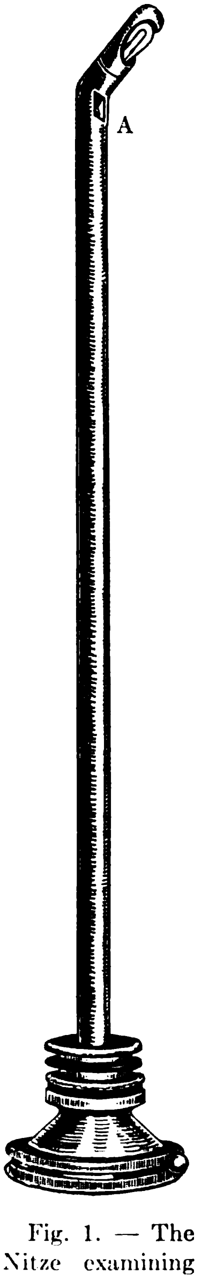

Fig. 1. — The Nitze examining cystoscope.

A small lamp is placed in the tip of the instrument in such a way that the area which falls within the field of vision is clearly illuminated.

The beak consists of a hollow metal cap rounded at the end; on the surface corresponding to the window in the shaft it is fenestrated to allow the light rays of the small Edison electric lamp which is placed within it to illuminate the bladder. The window is closed by a glass partition which protects the small lamp, and at the same time prevents the lamp itself from coming in contact with the mucous membrane of the bladder. This beak is constructed entirely independent of the shaft and may be screwed into place in the socket on the end of the shaft.

The shaft of this instrument is a straight metal catheter-like tube about

No. 21 of the French scale in circumference, and about 21 cm. in length. It contains the lens system for transmitting, amplifying, correcting, and magnifying the bladder picture. The window is situated at A (Fig. 1), at which point the prism is fixed. At the vesical end of the shaft is a socket into which the beak is screwed and the platinum wire of the lamp, which appears as a short spiral, comes in contact with the platinum disk contained within the socket. This platinum disk is the terminal of a wire which runs along the inner wall of the shaft for conducting the electric current from the battery to the lamp. The other terminal of the lamp is connected with the metal wall of the sheath which serves to complete the circuit between the lamp and the battery (Fig. 2).

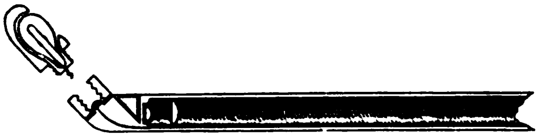

Fig. 2.—Sagittal section of the Nitze examining cystoscope.

When a lamp is burned out, or for some other reason becomes useless, the beak is unscrewed and a new lamp may be inserted in its place. This may be done without any more trouble than changing an ordinary lamp in the lighting system of a house.

The ocular end of the instrument is enlarged and is funnel-shaped, and contains a lens for magnifying the object viewed. Just in front of the lens are placed two rings, which encircle the shaft; these are arranged for attaching the wires from the battery by means of a coupler (Fig. 3), which is supplied with a device for turning on and shutting off the current. The current passes from the positive pole of the battery through the conducting wire in the branch of the coupler to one of the metal rings. From here it passes by means of an insulated wire on the inside of the shaft to the platinum disk in the socket at the end of the shaft.

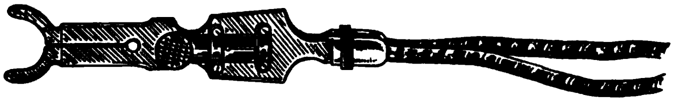

Fig. 3.—Coupler for attaching cystoscope to electric battery.

When the lamp is screwed in place the current passes through the spiral, which is in contact with the platinum disk, to the filament of the lamp. The connection is completed by a wire in the metal capsule or tip, by which the current is conveyed to the metal tube of the shaft back to the second ring and thence through the other branch of the coupler back to the battery.

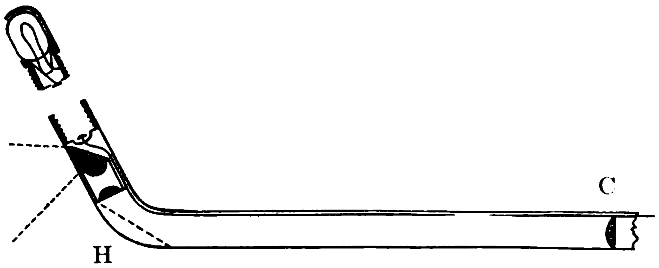

Fig. 4.—Sagittal section of a Nitze examining cystoscope for examining that portion of the bladder lying opposite the urethral opening.

Nitze constructed a second cystoscope in which both the lamp and the prism are contained in an elongated beak, the window being on the convex surface of the angle, as shown in Fig. 4. With this instrument he was able to obtain a clearer and more distinct picture of the bladder.

Referring to the illustration (Fig. 4), it shows a prism which receives the picture of the object lying opposite to it in the bladder and conveys it through two convex lenses to a mirror H, which, in turn, conveys it through a lens C in the middle of the shaft, finally to the end of the tube, where it is magnified and seen by the observer.

The third type of cystoscope constructed by Nitze was the so-called retrograde cystoscope, his object being to make possible an examination of the urethra and the surrounding portions of the bladder wall. The construction of this instrument is similar to that just described with the exception that the beak is placed almost at a right angle to the shaft, and the prism looks out at the concavity of the angle.

The cystoscope No. 2 is suitable for examinations of the base of the bladder, the lateral walls, and the portions of the bladder opposite to the urethral orifice.

Cystoscope No. 3 is suitable for examinations of the urethral orifice and prostate.

However, with sufficient skill any part of the bladder may be satisfactorily examined with the cystoscope first described. For cases with especially long urethræ, as in the case of prostatics, it may be necessary to use a cystoscope of greater length.

The next important step was the introduction of an irrigating device, which made it possible to change the medium without removing the instrument. It frequently happens during the course of an examination that the distending fluid becomes clouded by pus or blood, and unless the bladder can be washed out again and clear fluid introduced, the examination must be abandoned. To accomplish this, two special canals were constructed within the sheath of the instrument, especially for irrigation. The openings at the vesical end were near the prism.

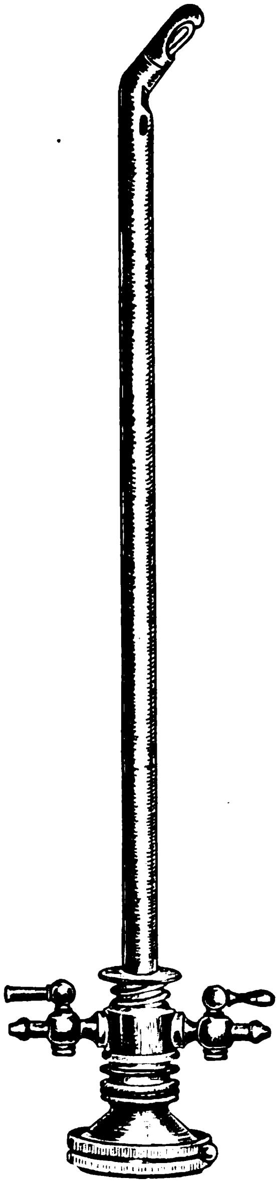

Fig. 5.—The Nitze irrigating cystoscope.

The Leiter instruments, which were constructed at about the same time as the newer Nitze cystoscopes, show some slight improvement, but the general principles are the same.

Boisseau du Rocher, in 1889, constructed an instrument which he called the *megaloscope*. It was a new type of instrument and consisted of a sheath which carried a removable electric incandescent lamp in its beak and a telescope which contained the optical apparatus, which was introduced separately.

The instrument was introduced into the bladder with the obturator in place. In the lower wall of the sheath were two small canals which formed a special double-irrigation apparatus and served simply to keep the bladder medium clear. This instrument differed from the cystoscope in that it had no prism, and Casper states that the instrument is awkward and unsuitable for use.

It is true that this instrument gave a direct view within the bladder and provided two tubes for simultaneous catheterism of both ureters, but it was so large and cumbersome that it caused the patient too much pain, and, further, catheterizing the ureter with the instrument was almost impossible.

The cystoscope of Gueterbock (Fig. 6), which was invented in 1895, and that of *Fenwick* were very similar. The Gueterbock consists of a sheath and telescope which are separate. The sheath is constructed just like a metal catheter with a moderately curved beak. This is passed into the bladder and then the telescope, which carries both the lamp and the lens, is introduced, and the lens and lamp of the telescope fall opposite to the corresponding openings in the sheath. The bladder is first washed out through the metal catheter and filled with water and then the inner tube is introduced.

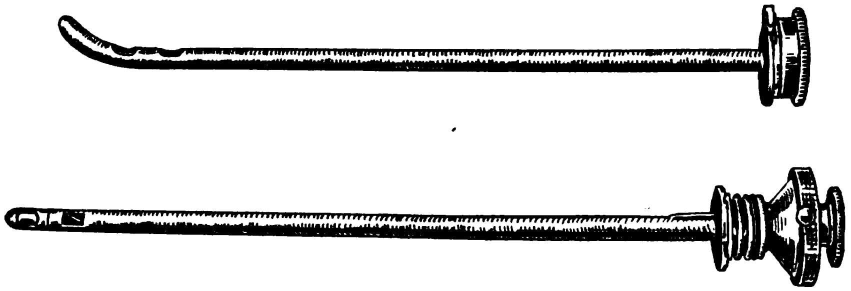

Fig. 6.—The Gueterbock cystoscope.

In 1897 *Nitze* presented his *evacuation cystoscope.* This consisted of a sheath and telescope, so constructed that when the instrument was in the urethra the telescope could be removed, leaving the hollow metal sheath in place. Through this the contents of the bladder could be evacuated.

The *Kollmann cystoscope,* which was presented in 1900, was a further modification of the Gueterbock instrument in that it consisted of a sheath and three removable telescopes—one for observation, one for irrigation, and one for double catheterism.

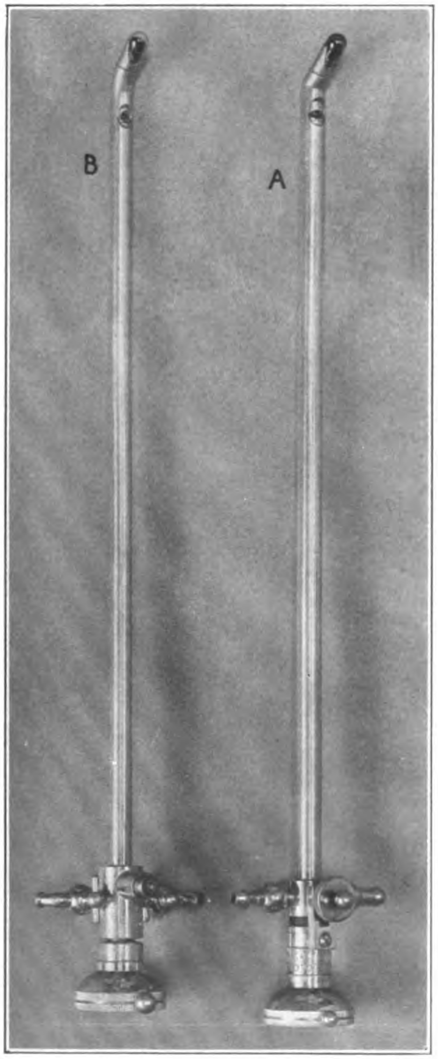

Fig. 7.—A, The Otis examining cystoscope, and B, the Brown modification.

The *observation cystoscopes of Albarran and Brenner* presented no special features of interest, except that the Brenner instrument provided a direct vision telescope whose use was limited.

The *retrograde cystoscope of Schlagintweit* was ingenious, but was complicated, and has been replaced by other and simpler instruments of American manufacture.

The cystoscopes which have thus far been described represent the combined efforts of many workers in Europe. At this point in the development of the cystoscope, American surgeons entered the field, and one of the first American cystoscopes was made by Wappler, of New York, for Dr. Otis. The instrument as devised by him, introduced a sheath and removable telescopic type of instrument with his new lens system. (Mr. Reinhold Wappler evolved the principle of entirely eliminating the prism and substituting in its place a hemispherical lens, the plane surface of which was silvered, and a portion of the circumference filling and closing the window in the tube of the telescope as in the case of the prism.)

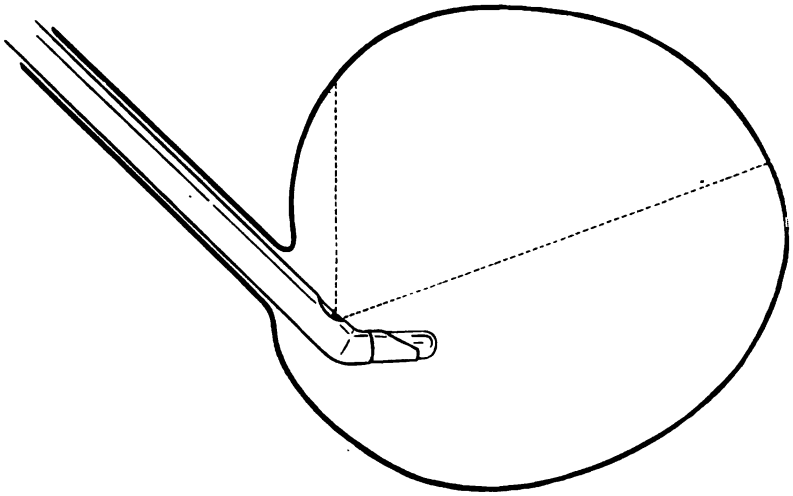

Fig. 8.—The field of vision of the Otis examining cystoscope.

The substitution of the hemispherical lens is the same as the addition of two convex lenses, one of which collects the rays at a wide angle and brings them together on the hypothenuse, and the other which corresponds to the first lens in the telescope. The instrument consists of the external metal catheter or sheath which conveys the illuminated lamp, and the telescope which contains the entire optical apparatus. A short beak is set at an obtuse angle to the shaft, and contains in its tip the electric lamp. The lamp is very brilliant and is of the so-called cold-lamp type, being practically free from heat, which does away with any danger of injury to the mucous membrane.

The lamp illuminates a larger area of the bladder than any of its predecessors (see Fig. 8), being in size equal to the full external caliber of the instrument. It is attached to the instrument after the method devised by Nitze. One pole of the lamp is carried on the metal of the sheath itself and the other by a specially insulated wire which does not encroach upon the internal caliber of the shaft, and therefore allows a telescope considerably larger than that of other instruments of the same external measurements. The size of the instrument is No. 20 of the French scale.

The lens is set in an oval window in the telescope.

At the ocular end of the instrument is a short screw fixed at a right angle to the shaft, which supports a small metal ball and indicates the

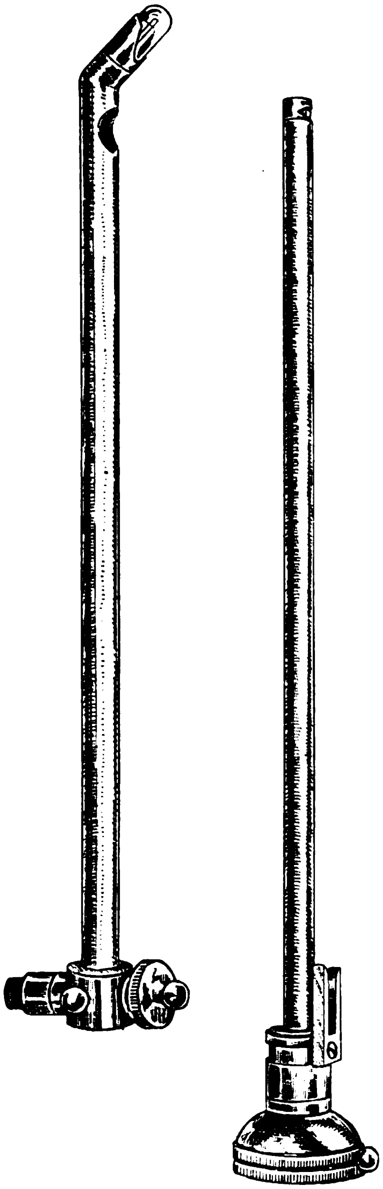

Fig. 9.—The component parts of the Otis examining and irrigating cystoscope.

position of the beak when the instrument is in the bladder (Fig. 9). A thumb-nut on this screw serves to clamp the telescope firmly in position. Opposite this screw, on the under surface of the sheath, is a metal post with an insulated core. This carries the electric terminals of the lamp and connects with the cords from the battery by a screw socket. This post is immovable, which is a distinct advantage over the Nitze type of attachment. Besides this, the shaft is also supplied with small stop-cocks placed within the post for the introduction of air when it is necessary to use this as the distending medium. The telescope contains the ocular apparatus and the vesical end contains a window into which the hemispherical lens is set. The proximal end has a funnel-shaped eye-piece and in addition a device for fastening the telescope firmly to the sheath after it is in place, allowing at the same time free rotation of the telescope within the sheath. This is especially important because it allows the operator while introducing the instrument to so rotate the telescope that the lens is entirely concealed within the sheath, and in this way cannot become smeared during its introduction.

After the instrument has been introduced, the lens is brought opposite the opening in the sheath as indicated on the ocular end by a small knob corresponding to the knob on the thumb-screw. If it is found desirable to change the medium in the bladder because of its becoming cloudy at any time, or on account of bleeding, the telescope may be removed and the bladder washed out through the sheath, which then becomes an evacuating catheter. The telescope is then replaced, and the examination continued.

The point of greatest importance in recommending this instrument is its large field of observation. It is claimed that it gives a field having an area four times as large as that of any other rectangular cystoscope, so that it makes possible a complete examination of every portion of the bladder without loss of definition; the large lamp which is used gives a brilliant illumination, and one sees a clearer and more distinct picture because of the greater calibre of the telescopic tube and the arrangement of the lens system. It gives also a distinct view of distant objects. The instrument also permits the use of air as an examining medium when this is of advantage.

The beak is short and the sheath is round and there are no sharp angles, which renders the instrument easy of introduction; the possibility of converting the instrument into an evacuating catheter is of very great advantage.

The instrument is made in this country and thus long delays in having repairs done are avoided.

THE LIGHTING APPARATUS

The source of the electricity for illuminating the lamp may be either the street current, a dry-cell battery, a wet-cell battery or a storage battery. It must be remembered that two kinds of current are furnished for lighting houses, *i. e.*, the direct or continuous and the alternating current, and the operator must use a resistance coil for the continuous or direct current or a transformer for the alternating current. Under ordinary circumstances, however, the dry-cell battery is by far the most satisfactory to use.

Regulating and Reducing Incandescent Current.—A number of devices have been constructed for this purpose.

The Wappler Controller No. 3 * is one of the most simple, and is safe.

It may be used with either a direct or an alternating current, and can be attached to any of the ordinary sockets for the reception of an incandescent bulb. It very much resembles a lamp socket, except that it has a large body on which is wound a high resistance wire from which a shunt current is derived. No danger results from a short circuiting of the wires coming from the controller, but care is to be taken that no contact is made with any metal conductor leading to the ground, such as radiators, water and gas pipes, as one of the wires from the main is connected to the ground. The one touching may happen to be of opposite polarity and blow out a fuse or do some damage to the instrument.

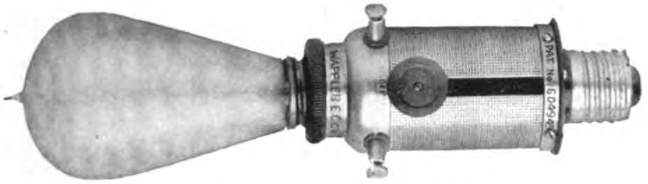

Fig. 10.—The Wappler controller for regulating and converting electric current.

A varied range of current may be had with this controller. If a 16 candle power lamp is inserted in the socket, one-third ampere and from 0 to 25 volts can be obtained from the binding post; with a 32 candle power, eight-tenths ampere and about 40 volts can be had. A rack-and-pinion movement makes it possible to increase the voltage by steps of one-third of a volt.

A blue lamp is recommended for use with the controller,

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* The Wappler Electric Controller Co., 175 E. 87th St., New York City.

thus shutting out the bright glare when diagnostic examinations are made.

A controller of somewhat similar design is made at Rochester, N. Y.* It is a little larger, but serves the same purpose.

Transformers.—There are also numerous transformers which are too large to be portable, but which are useful for office and hospital work.

Dry-cell Batteries.—For universal use and safety the dry-cell battery is by far the best. It may be secured in almost any shape and size desired. For office use an eight-cell battery with rheostat is preferable. It has a lighting capacity of from eight to fifteen hours. It holds a charge about nine months. Such a battery may be secured from almost any dealer in electrical supplies. Wappler makes a dry-cell pocket battery which is so small and compact that it can be easily carried in the pocket or instrument bag. It is especially useful when making examinations at a patient's home. The one which we would recommend is a six-cell battery, which is 11½ inches long by 3½ inches wide and 1½ inches thick. It holds its

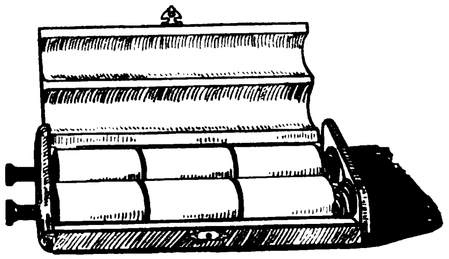

Fig. 11.—A Wappler pocket size dry battery.

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*Electro-Surgical Instrument Co., Rochester, N. Y.

charge about one hundred days with a capacity of two or three hours if used with the high-efficiency lamps. Each battery is supplied with a small rheostat to regulate the strength of the light. It is very simple in construction, and the cells can be replaced by the physician himself at a moment's notice. The one essential thing is to have a source of illumination which can be absolutely depended on, and which may be used without danger of shocking the patient. All things considered, the dry-cell battery is to be preferred, being perfectly safe and easily transported.

CHAPTER II

THE DIRECT EXAMINING CYSTOSCOPE

ENDOSCOPIC tubes, with or without a glass partition, when used to explore the bladder, offer so limited a field of vision that the observer is given only an imperfect impression of the true relations as they exist in the bladder. In order to increase the field of vision without increasing the diameter of the instrument, Nitze introduced a system of lenses. This allows the cystoscopist to observe a much larger area of bladder wall, and he can form a better judgment of the object seen by comparing it with other portions of the bladder which appear in the same field.

Construction.—In the simplest direct-vision cystoscope, the tube contains an objective which consists of one or more lenses, a middle lens and an ocular lens. An object is received by the first lens and is projected near the posterior surface of the lens as a true inverted image greatly diminished in size. This image is so small that the details cannot be clearly seen at the ocular end of the tube. In order to bring the image to the eye of the observer, a second lens is so placed in the center of the tube that it receives the image A, reinverts it and projects it to the other end of the tube and forms an image about half-way between the middle lens and the ocular lens. The ocular forms the size of the image by magnifying it and enlarging the upright image. When the rays pass through the first lens at the distal end of the tube, the straight lines become curved and many of the light rays are absorbed. In order to correct this spherical aberration and to preserve the intensity of the light rays, a second lens is added to the objective, being placed directly back of the front lens. This gives a clear field of vision with all straight lines reproduced straight.

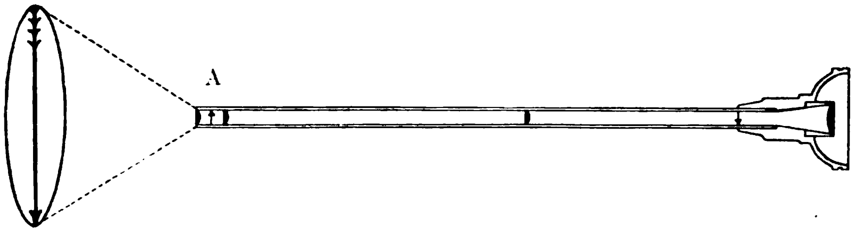


Fig. 12.—The lens system of a simple direct vision cystoscope.

Lens No. 1 condenses the rays. Lens No. 2 corrects the distortion and preserves the intensity of the light rays. Lens No. 3 reinverts the image and projects it to the ocular end of the tube, and Lens No. 4 magnifies the upright image.

By the use of this series of lenses the observer is able to

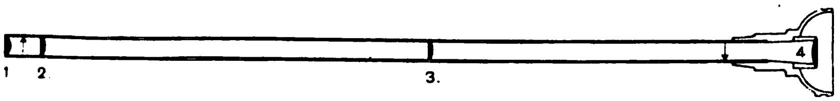


Fig. 13.—The telescope of a direct view cystoscope, showing arrangement of lens.

see clearly a relatively large area of the opposite bladder wall in its normal proportions.

The lens absorbs many light rays. The details of an object are very much more clearly seen by the unaided eye than through the system of lenses contained in a cystoscope. The more the ocular lens magnifies, the stronger must be the illumination of the object viewed.

The Field of Vision.—If the operator looks through a direct vision cystoscope of the modern type, he sees the object in its true position. The nearer the object is to the lens, the larger it will appear and the clearer will be the details of it, and conversely; but within the limits of the bladder, provided the illumination is sufficient, no objects lying opposite the lens will be entirely out of focus. In the modern instruments the lenses have been so perfected that very little distortion will be noticed unless the lens almost touches the object.

Much has been written concerning the error of judging the morphology of an object as seen in the bladder, because the parts nearer the lens are magnified and the more distant parts are diminished in size, but actually the amount of distortion is so slight that it is quickly appreciated when the instrument is moved about. The greatest source of error, however, is in judging the size of an object, but even this can be correctly estimated after a little practice.

It should be emphasized that only when one portion of the object is almost touching the lens of the cystoscope and the distal portion of the object is considerably removed from the lens, is any marked distortion to be seen.

The degree of distortion is seen when the objective lens is practically on a level with and almost touching the object. By removing the lens a slight distance from the object and raising it a little the distortion is seen to be so slight that it is practically eliminated.

A second form of distortion is that due to the difference between the inner and outer field of vision, the central rays of the cone being more magnified than the outer rays. For example:

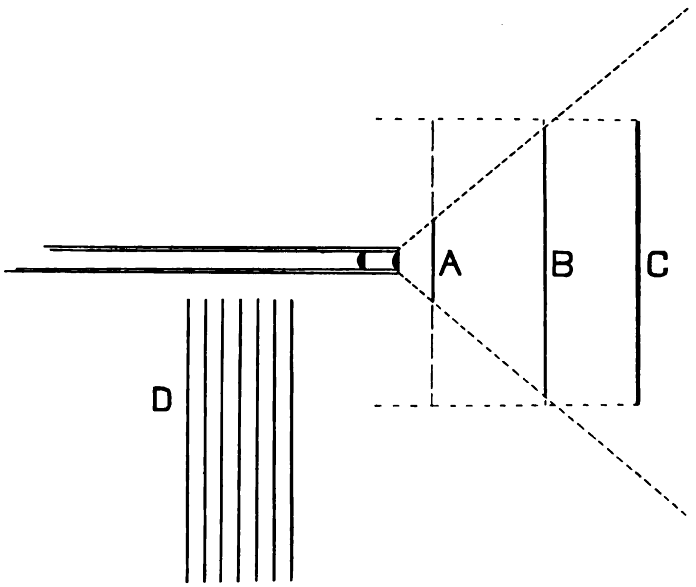


Fig. 14.—Diagram showing field of vision of a direct examining cystoscope. The object viewed is shown at "D" . When placed at the distance "A" from the lens, the lines are distorted, as seen in Fig. 15, "A". When the object "D" is further removed from the lens and it occupies the position of the line "B", the lines appear only slightly distorted, as seen in Fig. 15, "B". When "D" is placed at distance "C", the object appears undistorted, as in Fig. 15, "C".

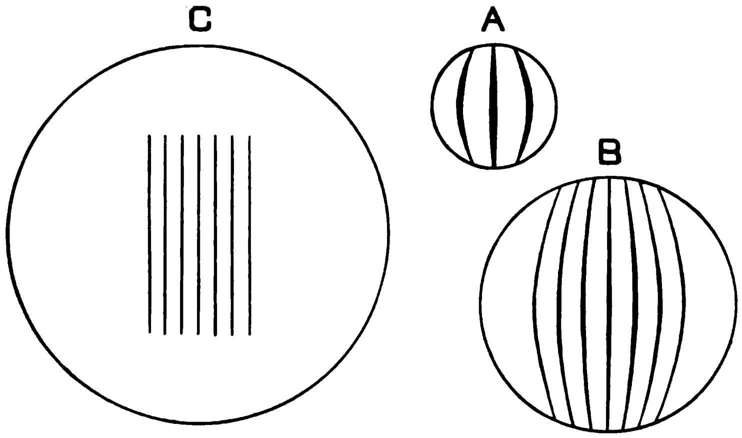


Fig. 15.—Figs. "A", "B", and "C", showing the image of objects as indicated in Fig. 14. "A" shows the distortion of an object placed close to the lens. "B" shows the distortion of an object still further from the lens. 'C" shows the image of an object at the proper focal distance.

The point of practical value to be remembered from these observations is that any object lying near the urethral orifice, such as a median lobe of the prostate, or calculi in this position, and pathological conditions of the trigone when viewed with a direct lens cystoscope, appear magnified and somewhat distorted, whereas objects lying at about 3 cm. from the internal urethral orifice appear in their normal proportions when viewed from that distance.

CHAPTER III

THE INDIRECT EXAMINING CYSTOSCOPE

THE PRISMATIC CYSTOSCOPE

THAT portion of the wall of the bladder which lies opposite the entrance of the urethra may be easily viewed by means of the direct examining cystoscope. In fact, the observer sees the object in its proper proportions and without any distortion other than that already described. When one wishes, however, to examine the dome of the bladder or the vesical neck, the prostate, or to obtain a bird's-eye view of the trigone, it is necessary to introduce a reflecting device—the prism. It is especially necessary in examining the male bladder, whereas in the female bladder the operator is able to explore much further with the direct cystoscope, on account of the shortness of the canal and the fewer points of fixation; so that for gynecologic examinations, for ureter catheterism, and for operative procedures the direct cystoscope may be used. However, after a number of years of experience with both types of instrument, the writer believes that the indirect examining cystoscope, using a reflecting prism, is by far the easier and more satisfactory instrument to use. The slight disadvantage of looking at an object reflected in a mirror is easily discounted.

Construction.—The prism introduced by Nitze was placed near the end of the shaft of the cystoscope where the beak joins it, and a window was cut in the concave side of the instrument. In this window was fixed a right-angled prism made of glass which entirely filled the opening. The side of the prism forming the hypothenuse, which lies diagonal to the axis of the cystoscope, is silvered and forms a reflecting glass placed at an angle of 45 degrees. The light rays enter through the window and are reflected by the mirror at an angle of 90 degrees in the direction of the axis of the objectives, and this reflected picture is carried to the eye of the observer just as in the case of the direct examining cystoscope.

By this method we do not see the object directly, but in a mirror, and we have to deal with all of the peculiarities of the reflected picture. At first this is confusing, but one rapidly becomes accustomed to the conditions and the relative position of what is seen is easily appreciated. It is exactly the same as the picture seen by the laryngoscope. It is very essential that the beginner should study the principles of the prism, and it is better to first study a few pictures and diagrams and then study the bladder picture directly, than to waste time by the use of phantoms and the like.

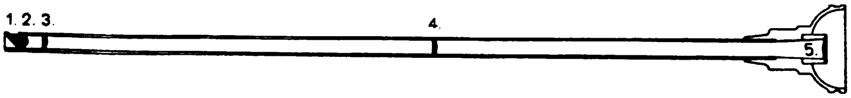


Fig. 16.—The lens system of the indirect view examining cystoscope with reflecting prism.

The Picture.—The image as viewed from above by aid of the Nitze reflecting prism shows the object upside-down (Figs. 20 and 25), but the right side remains right and the left side remains left. When, however, the instrument is rotated on its axis and lowered to the same level with the

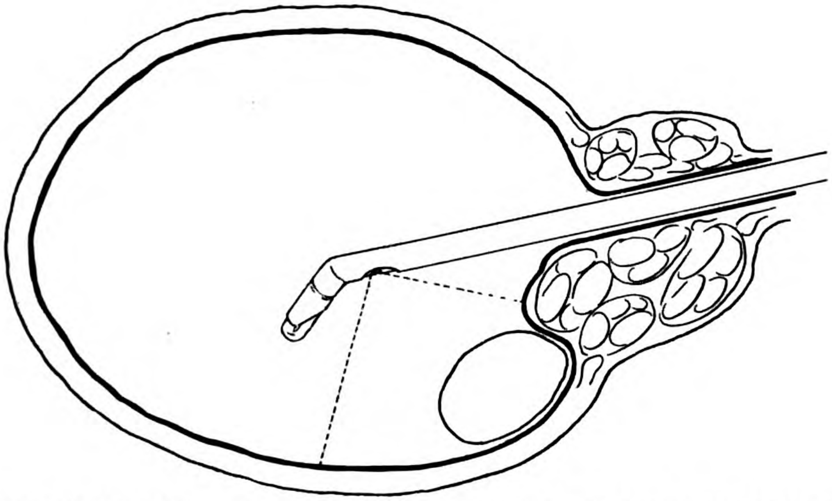


Fig. 17.—The Otis examining cystoscope in outline, with beak in the bladder.

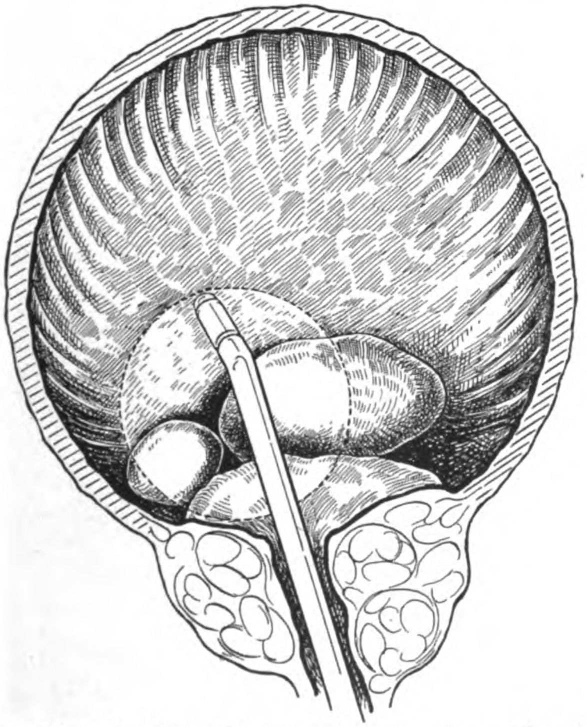


Fig. 18.—The field of vision with an Otis cystoscope. View from above.

object, it will be seen that the image also moves, the picture being at right angles to the object (Fig. 26). One simply has to remember that he is looking at an inverted picture as seen in a mirror. Although this seems a little confusing, still practically it makes no difference, and the cystoscopist soon learns to give the picture its proper value without attempting to invert the picture in his own mind.

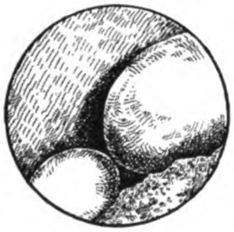


Fig. 19.—The cystoscopic view seen in Fig. 18 viewed through the Pilcher correct vision cystoscope.

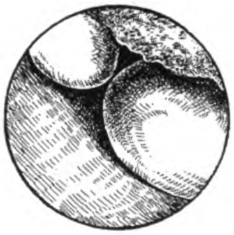


Fig. 20.—A cystoscopic picture of the same view with the Nitze prismatic cystoscope.

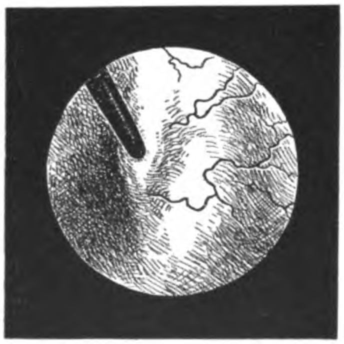


Fig. 21.—Cystoscopic picture of a catheter entering the ureter.

The Prism.—Nitze placed the prism in front of his first lens. Schlagintweit modified this arrangement, placing his front lens first and the prism next, the only advantage being that in this way it could be mounted in the round tube and fitted more accurately.

Fig. 22 shows the arrangement of the lenses in the tube. The front lens is mounted in front of the prism and the prism has a focus ground opposite the reflecting surface.

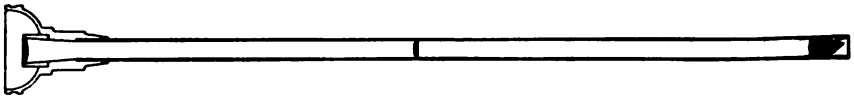


Fig. 22.—The Schlagintweit lens system.

In the Otis-Brown system (Fig. 23) the prism is substituted by a reflecting hemispherical lens, the plane surface of which is silvered; a portion of the circumference of the lens filling and closing the window in the tube of the telescope as in the case of the prism. The use of this lens is the same as the addition of two convex lenses, one of which collects the rays at a wide angle and brings them together on the hypothenuse, and the other which corresponds to the first lens in the telescope. By placing the reflecting surface at certain angles to the axis of the telescope, oblique forward, right angled, and retro-vision may be obtained.

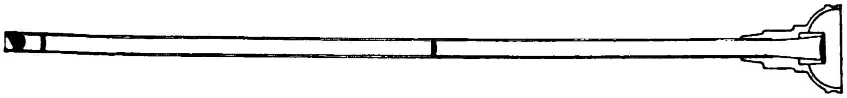


Fig. 23.—The Otis-Brown lens system.

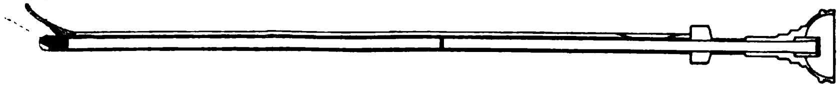


Fig. 24.—The lens system of a Brown telescope for oblique forward vision.

Telescope for Oblique Forward Vision.—This was

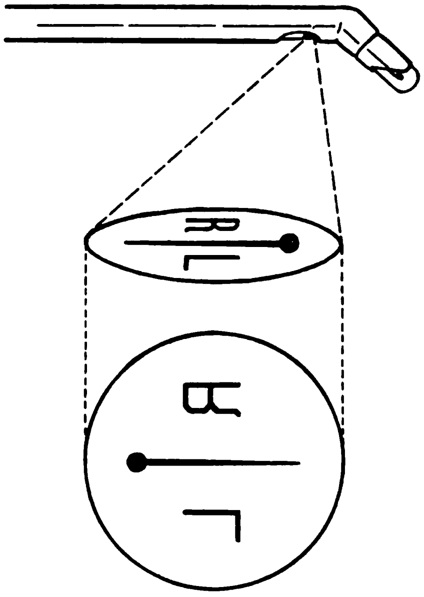


Fig. 25.—Diagram showing the image of an object when looked down upon through a prismatic cystoscope. Everything will be observed to be upside-down, but the right side, "R", appears on the right of the picture, and the left side, "L", appears on the left of the picture.

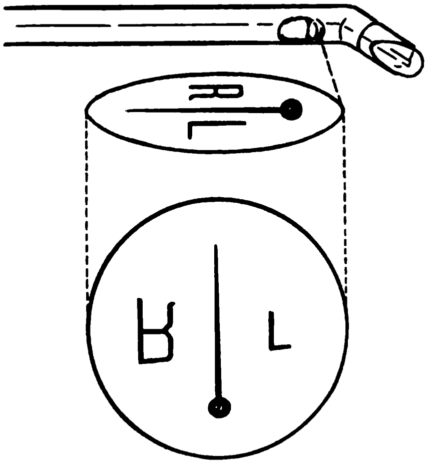


Fig. 26.—The same object as in Fig. 25 viewed through a prismatic cystoscope which has been partially rotated; the instrument is on the same level with the object—a side view. It will be noted that the image is rotated, the picture being at right angles to the position which the object occupies; also that the side farthest from the lens looks smaller and somewhat distorted.

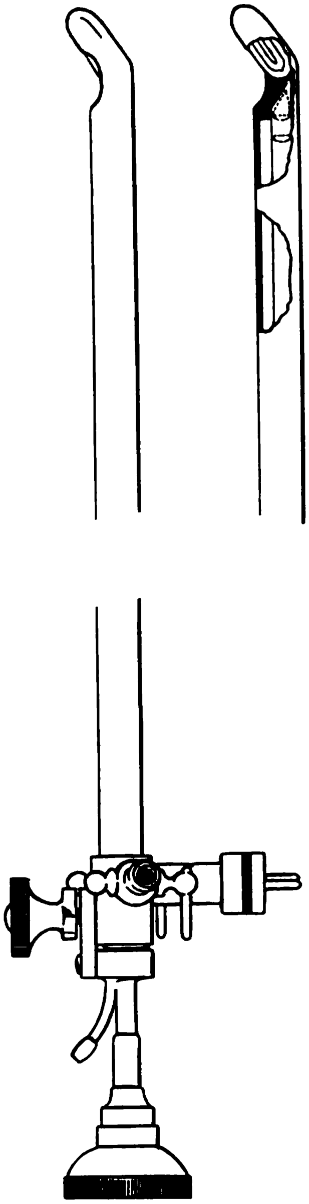


Fig. 27.—Two views of the Pilcher close-view correct-vision endoscope. This instrument may be used as either a urethroscope or a cystoscope. The figure on the left shows the beak of the instrument, which is only slightly curved. The other figure shows arrangement of the lamp, the lens, and the tube for applications. With this instrument objects can be clearly seen at a distance of one-eighth of an inch from the lens.

designed to be used in the sheath of the direct catheterizing cystoscope. The novel feature is that one optical piece combines the front lens, prism, and back lens.

THE CORRECT-VISION CYSTOSCOPE

The lens system of the American cystoscope has been greatly improved recently by the American cystoscope makers, by designing a prism with two reflecting surfaces. The second reflection re-reverses the image, thus presenting it to the eye right-sided and upright. Incidentally, this new arrangement of front lens, double reflecting prism, and back lens, which has been worked out by R. Wappler, offers many constructional advantages, such as the largest possible angle of vision with the least spherical aberration, the best possible illumination of the image with reference to size of telescope tube, its length, angle of vision, and magnification. The image is seen at right angles, the same as through a direct-vision telescope.

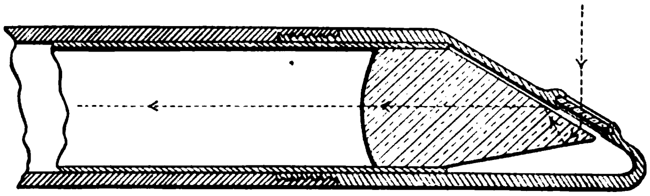


Fig. 28.—Arrangement of the lens system in the objective of a Pilcher close-view correct-vision cystoscope.

The drawing (Fig. 28) shows the new lens and prism arrangement of the correct-vision objective. The surface of the prism adjacent to the small front lens, whose length is greater than its diameter, is not silvered; nevertheless, it reflects the rays perfectly. This unsilvered surface reflects the second time; it first lets the rays pass through to a smaller silvered surface, which is almost in line with the axis of the telescopic tube. The fact that this surface is unsilvered, and serves the incidence as well as the reflection, enables one to combine the highest optical qualities with the simplest possible device. (See Figs. 27, 28, 29, 30.)

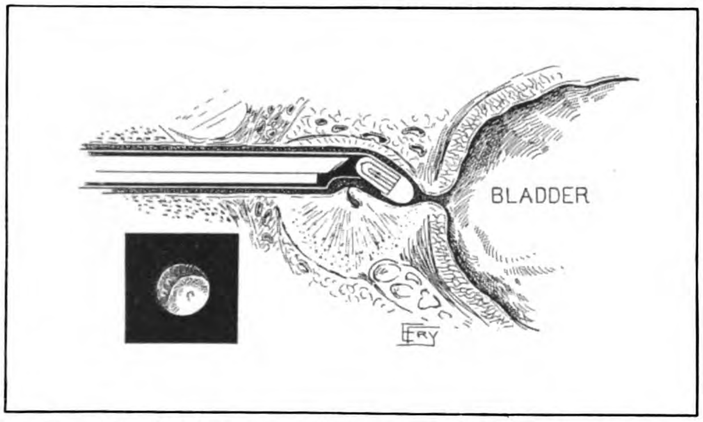


Fig. 29.—The Pilcher close-view correct-vision endoscope used as a urethroscope. In the left-hand lower corner the view as seen through this instrument is shown. The verumontanum and some of the prostatic ducts are seen.

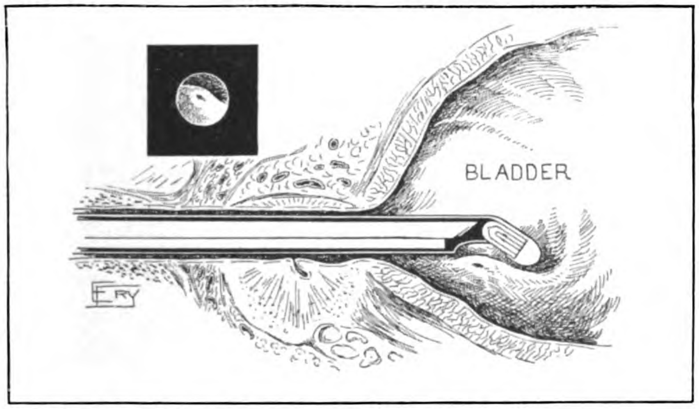


Fig. 30.—The Pilcher close-view correct-vision endoscope used as a cystoscope. In the upper left-hand corner in the black square is shown an image of the ureter opening as seen when the instrument is brought close to the object.

CHAPTER IV

THE URETER CATHETERIZING CYSTOSCOPE

In the previous chapter only the instruments for examination of the bladder have been considered. Their construction is comparatively simple. When, however, it is desired to pass catheters into the ureters in order to collect the urine separately from each kidney, the addition of tubes or canals for conducting the catheters into the bladder becomes necessary, and when the prism cystoscope is used a deflecting device or elevator placed proximal to the prism or lens is also required, in order that when the catheter emerges from its canal it may be lifted up and its direction controlled from the ocular end of the instrument. The instrument must be so adjusted that as the end of the catheter is lifted up and away from the instrument its tip will be clearly seen within the field of the lens. It is also of great advantage to have an instrument provided with two catheter canals, so that both ureter openings may be sounded at the same sitting without withdrawing the instrument. The catheter canal, being tubular, may at the same time be used for purposes of irrigation, a measure which is absolutely essential to success in many cases.

If the simple lens cystoscope which is used for direct vision be provided with catheter canals, there is no need for any deflecting device, and we have a very simple type of instrument.

THE DIRECT CATHETERIZING CYSTOSCOPE

Brenner Cystoscope.—In 1887, Brenner presented before the German Surgical Congress an instrument for ureter catheterism which was probably the first practical instrument to be successfully used. Later he improved the mechanism of the instrument, and it remains to-day, with few changes, as one of the best of its class.

Boisseau du Rocher Cystoscope.—Similar instruments have been constructed by other workers. Boisseau du Rocher, in 1899, presented a composite instrument which consisted of a sheath carrying the light apparatus and a removable telescope. He also introduced two catheter canals in the lower wall of the sheath; these were designed especially for irrigation, but were also available for synchronous double ureteral catheterism. The conception of the Boisseau du Rocher instrument was brilliant, but its usefulness was not proved. The principles were correct, but the instrument was clumsy and not serviceable.

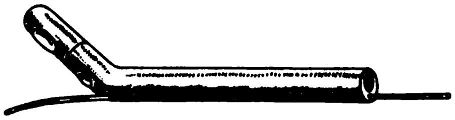


Fig. 31.—Vesical end of a Brenner catheterizing cystoscope.

Of the more modern examples of the direct type of instrument the most practical are those devised by F. Tilden Brown, of New York, and Bransford Lewis, of St. Louis, based on the models of Brenner and Boisseau du Rocher.

The Tilden Brown Cystoscope.—The instrument devised by Brown consists of a sheath and telescope, the sheath containing the illuminating device and the telescope

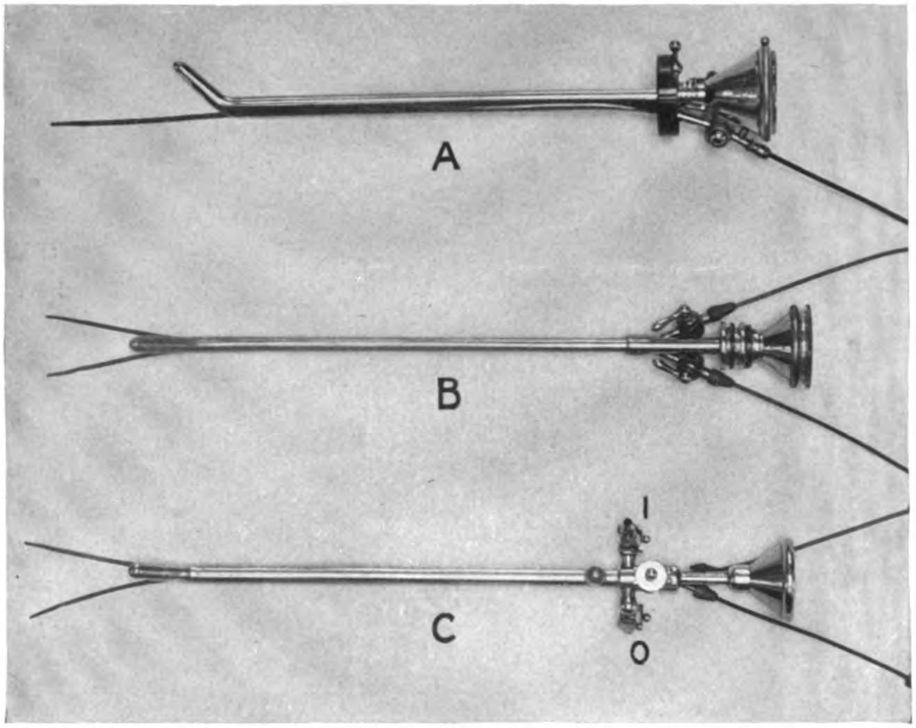


Fig. 32.—Brenner-Leiter, Brown-Leiter, and Brown-Wappler ureter-cystoscopes.

(A) Brenner. The first single-ureter catheter cystoscope, with direct-vision telescope looking through a glass window at the convexity. Made by Leiter of Vienna, 1887. Length of available ovoid staff, six inches = 15 cm. Circumference, 23 mm., using a hooded electric (Edison) changeable lamp—hot.

(B) F. Tilden Brown. The first double-ureter-catheter cystoscope, with direct-vision telescope looking through a glass window at the convexity. Made by Leiter of Vienna, 1898. Length of available ovoid staff, six inches = 15 cm. Circumference, 25.5 mm. Using a hooded electric (Edison) changeable lamp—hot.

(C) F. Tilden Brown. The original composite cystoscope, having an open sheath without glass window, into which were insertable a direct-vision, double-ureter catheter telescope, a direct-vision examining telescope, an indirect-vision (prism) examining telescope and later examining telescopes of varying degrees of indirect vision (different approximations of the spherical lens). In addition provision for independent water conduits was made (1 and 0, Fig. C). Made by Reinhold Wappler of New York, 1901. Length of available cylindrical staff, five and a half inches = 14 cm. Circumference 25 mm. Glass-enclosed "cold" lamp (Preston-Koch)—wholly exposed.

containing the optical tube and the catheter canals. The instrument is adapted to both sexes for synchronous ureter catheterism with either water or air distention of the bladder.

The sheath being open allows of several other telescopic tubes being used, the same sheath being sufficient for each.

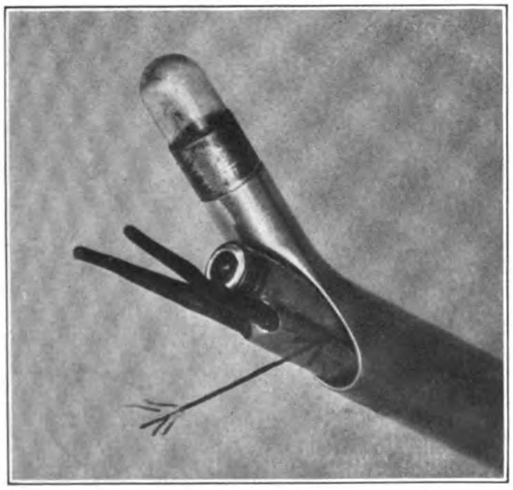


Fig. 33.—Beak (much enlarged) of a Tilden Brown composite cystoscope with the double-catheter telescope protruding from the sheath. The changeable electric lamp (cold) is inclosed in a glass cap, over which the usual metal hood is omitted, in order that the various telescopes can find their different visual fields equally illuminated. The arrow points to one of the lateral irrigating or evacuating canals afforded by a triangular waste space between the inside of the sheath as base, and the outer surface of the telescope and catheter tube.

The instrument affords a large field of direct vision and is perfectly illuminated by an incandescent lamp of the so-called "cold" type. It allows of double-ureter catheterism; it makes possible a rapid irrigation of the bladder or interchange of the distending medium while any of the telescopic tubes are in the sheath.

The sheath is an oval tube carrying the illuminating lamp and its insulated electric conductor. At the proximal end of the instrument are two cocks for irrigating. There is also a screw for holding in place the obturator or the telescope. The telescope contains the lens system, and attached to it are two channels or gutters for guiding the catheters. The entrance to each channel is a small metal tube large enough to accommodate a No. 6 ureter catheter, and the entrance to each of the canals is provided with a thin rubber tube which fits snugly around the catheter and prevents leakage. The sheath is provided with an obturator which is inserted before the instrument is passed through the urethra into the bladder. When this has been safely accomplished, the obturator is removed and the telescope, bearing the catheter canals and armed with the catheters, is inserted in its place.

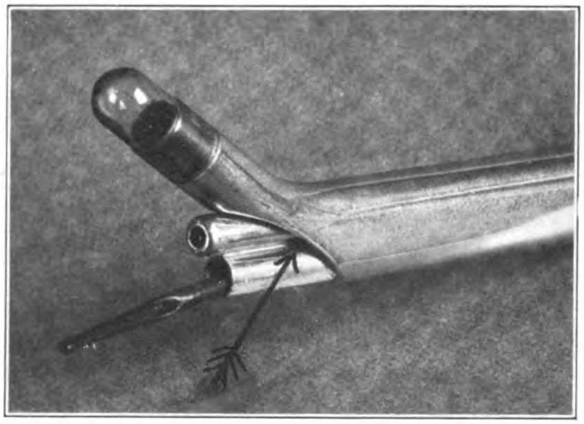


Fig. 34.—Beak (much enlarged) of an oval-sheath F. Tilden Brown composite cystoscope showing the telescopic tube attached to a single much larger one, serviceable as the conduit for a very large ureter catheter, or a tube of radium, or such instruments as forceps and scissors.

Lewis Cystoscope.—Bransford Lewis has devised an instrument for synchronous catheterism of both ureters. It is based on the principles of the Brenner instrument, providing two catheter canals. Its construction may be seen from the illustrations. (Figs. 54, 55, 56, 57, 58.)

THE INDIRECT CATHETERIZING CYSTOSCOPE

The Nitze Catheterizing Instrument.—In 1894 Nitze constructed a ureter cystoscope with a lamp on the concave side of the beak of the instrument, by adding to his prismatic instrument a tube for conveying a ureter catheter.

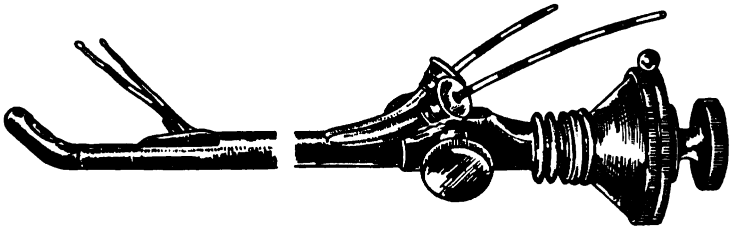


Fig. 35.—The Nitze indirect catheterizing cystoscope.

The next year Casper devised an instrument adopting the prismatic system of Nitze, but on the upper surface of the instrument he placed a half-open catheter canal with a sliding metal cover which was controlled from the ocular end of the instrument. The catheter was passed through this canal, and as it emerged at the end its direction was controlled by narrowing or enlarging its point of exit by the manipulation of the sliding metal cover. Pushing forward the metal cover or slide made the exit opening smaller and caused the catheter to bend more sharply away from the instrument. The construction may be better seen by referring to Fig. 37.

In 1897, Albarran presented an instrument with a deflector at the distal end of the catheter canals consisting of a lever very much like a finger which was controlled by a screw at the ocular end of the instrument. While the instrument is being introduced into the bladder the deflector lies perfectly flat on the instrument. After the instrument has been introduced, the catheter is pushed forward until it passes over the deflector and lies over the prismatic lens (Fig. 36); then by turning the screw, the end of the catheter may be made to assume any angle up to ninety degrees. By the use of this deflector the catheter can easily be guided into the ureter. Nitze at once adopted this device of Albarran, and the principle of his later model (Fig. 35) does not vary much from that of Albarran's.

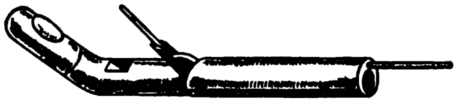


Fig. 36.—The Albarran indirect catheterizing cystoscope.

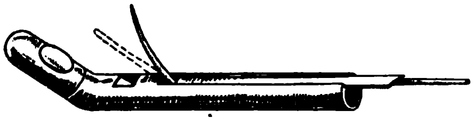


Fig. 37.—The Casper indirect catheterizing cystoscope.

All of the operators soon realized that in order to obtain the greatest degree of benefit from the use of these instruments, it was necessary to provide for the synchronous catheterism of both ureters, and most of the modern instruments have been provided with two catheter canals. The disadvantage of the instruments bearing the names of Nitze, Albarran, and Casper, is that they do not provide for a free irrigation of the bladder or interchange of medium, while the catheters are occupying the canals of the instrument. Also the deflector and opening where the catheters leave the instrument are so constructed that it makes removal of the instrument with the catheters remaining in the ureters almost impossible.

The disadvantages of the instruments may be put down as follows:

1. They are unnecessarily large.

2. They contain numerous rough angles.

3. They easily get out of order and must be sent to Europe for repairing.

4. They employ a hot lamp and there is constant danger of burning the mucous membrane of the bladder.

5. It is difficult to irrigate the bladder or exchange the medium therein without removing the catheters or the instrument.

6. It is almost impossible with safety to withdraw the instrument from the bladder and leave the catheters in place, because of the direction of the catheters themselves in passing from the canals in the cystoscope to the ureters, as they are curved in their course and are twisted on their axis and bind between the cystoscope and the urethra, being thus subjected to so much friction that one cannot be sure the catheter is not withdrawn from the ureter at the same time that the instrument is withdrawn from the bladder.

7. The lever which directs the course of the catheter

may easily become locked so that it does not lie flat on the instrument, and serious injury may be done to the mucous membrane of the urethra in withdrawing the instrument.

8. The instrument is so constructed that the complicated parts cannot be removed by the physician and properly cleaned.

Bierhoff of New York constructed an instrument which allowed of the dismemberment of the instrument so that the component parts could be more easily cleansed. His cystoscope is so constructed that the telescope containing the lens system and the lamp may be revolved within the sheath of the instrument while it is in place for observation. After the catheters have been introduced into the ureters, the beak of the instrument may be revolved without twisting the catheters; but in this type, also, there is considerable danger of pulling the catheters out of the ureters while removing the instrument. There is also a joint between the lamp-carrier and the telescopic tube which is so placed that if the beak of the instrument should become caught or engaged in the wall of the bladder, it would be possible in turning the handle of the instrument to unscrew the lamp and leave it in the bladder. This, however, is not a real objection.

The Pilcher Cystoscope.—In aiming to eliminate some of these disadvantages, the writer devised an instrument which consisted of three parts—a telescopic tube, a sheath, and a set of catheter tubes with deflector. All parts may be separated and thoroughly cleansed. All except the telescope containing the lens and lamp may be boiled and sterilized. The telescopic tube (Fig. 38) is

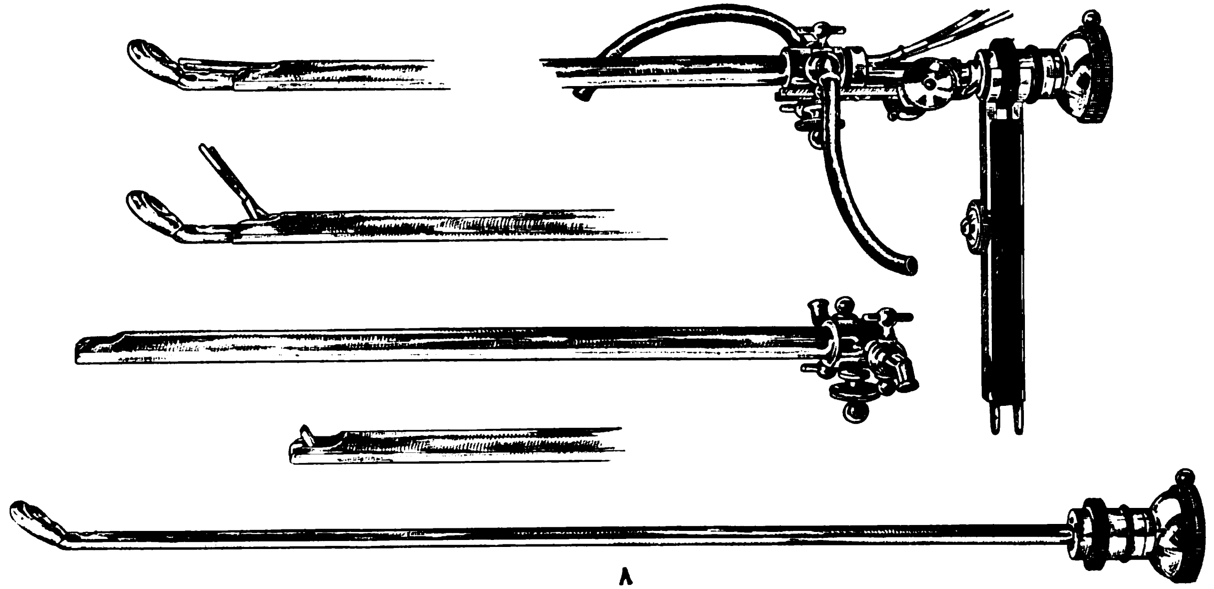


Fig. 38.—The Pilcher indirect catheterizing cystoscope. The upper figure shows the instrument complete with catheters in place, irrigating tubes, coupler, etc. Below this is seen the vesical end of the instrument with deflector, and the catheters protruding. The lower three figures show the sheath and the telescope of the instrument separated for cleansing. Fig. "A" shows the telescope, which is entirely independent of the other parts of the instrument, and may be used as a small examining cystoscope, No. 14 of the French scale.

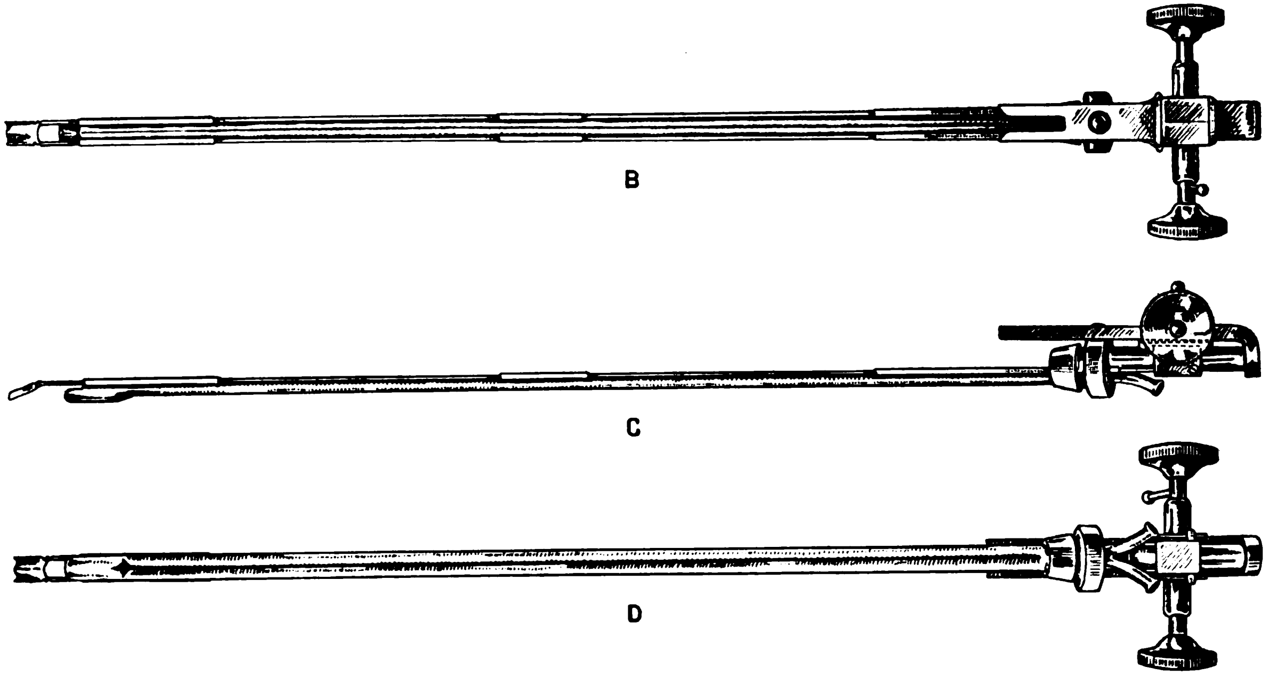


Fig. 39.—"B", "C", and "D" show different views of the catheter canals and deflector. This entire portion of the instrument may be boiled. Figure B shows a view of the superior surface of the part of the instrument carrying the deflector and the catheter tubes; Figure C, a lateral view, and Figure D, the inferior view of the same.

complete in itself, containing the lamp and lens; this may be used by itself as a simple examining cystoscope; its size is No. 14 French. Attached to this telescope is the device which carries the catheter tubes and a new type of deflector; these catheter tubes may be open or closed as the user desires. The deflector consists of a simple piece of steel hinged on a pinion between two parallel steel-wire bars; as the deflector is advanced, it strikes a slightly inclined plane that diverts its axis so that it assumes gradually a position at right angles to the instrument; its relation to the ends of the catheter-carrying device being such that the catheters are deflected to almost any angle desired, the tips of the catheters being, when properly advanced, always within the field of the lens.

The advantages of this instrument over those previously devised are:

1. That it may be properly sterilized after using.

2. That a relatively large catheter may be used.

3. That the deflecting device is so constructed that it cannot injure the urethra in the withdrawal of the instrument.

4. That the bladder may be irrigated while the catheters are in place.

5. That the opening of the sheath is so constructed that the catheter may lie flat in withdrawing the instrument and there is nothing to bind it as in other instruments; this is shown in Fig. 40, illustrating the catheter entering the ureter and the instrument prepared for removal.

The illustrations give a fair idea of the construction of this instrument, and, after using it for a year, the writer is satisfied with it for use in the female. The original instrument causes too much traumatism of the male urethra to be useful in men.

The Buerger Cystoscope.—About six months after the construction of this instrument for the writer, the same makers made for Dr. Buerger, of New York City, an instrument which shows some distinct improvements over that described above. It is the most useful indirect irrigating, observation, and double catheterizing cystoscope at present in use. Its development combines the ideas of many workers.

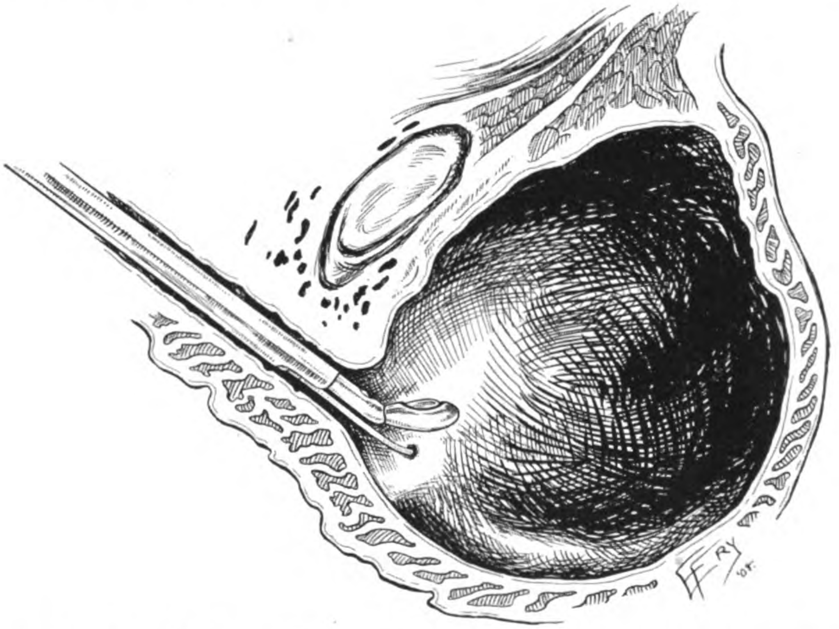


Fig. 40.—The Pilcher catheterizing cystoscope with catheter entering the ureter. The beak of the instrument with lamp attachment is turned without moving the sheath, as in the Bierhoff instrument. The catheter then lies flat without any angulation, and does not bind as the instrument is removed.

The instrument consists of three parts; the sheath, an obturator, and the catheterizing telescope. The sheath is circular on cross-section and has a short beak, which contains a cold lamp. The instrument is 8¼ inches in length and possesses a large fenestrum behind the lamp on the so-called concave side of the instrument. Its calibre is 24 of the French scale. The obturator, which is in place when the instrument is introduced into the bladder, is perforated so as

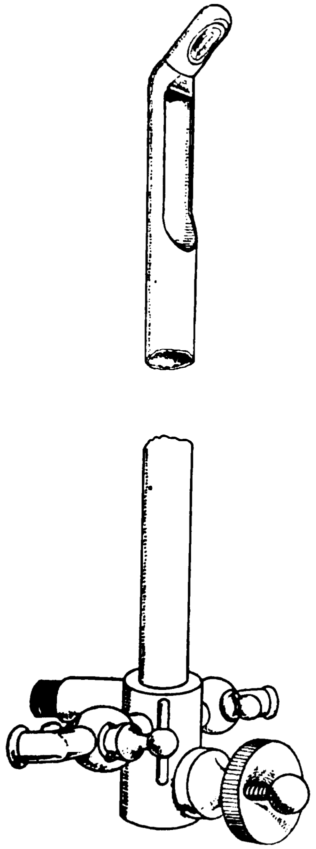


Fig. 41.—The sheath of the Buerger catheterizing cystoscope.

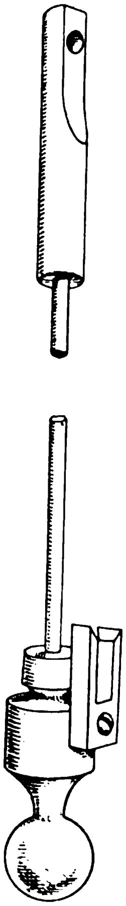


Fig. 42.—The obturator of the Buerger catheterizing cystoscope.

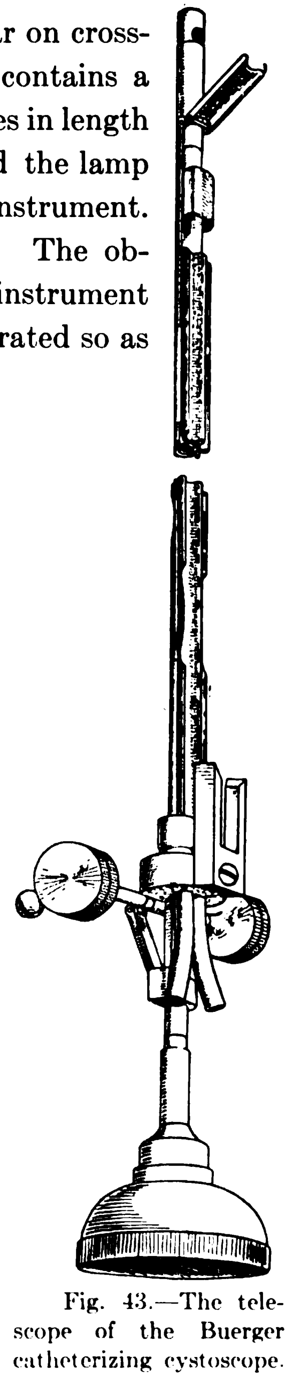


Fig. 43.—The telescope of the Buerger catheterizing cystoscope.

to allow of irrigation. The telescope combines the optical apparatus, the mechanism for deflection, and the catheter grooves. The instrument will permit the passage of two ureteral catheters, No. 7 of the French scale. The large deflector is placed between the lens and the proximal edge of the fenestrum and is constructed after the type of Albarran. This instrument, which is made by the American Cystoscope Makers, of New York, is by far the best instrument which has yet been devised for examining and catheterizing the ureter openings.

It has the following distinct advantages:

1. The sheath, when introduced into the bladder and the obturator removed, is practically a large evacuating catheter, No. 24 French size, allowing of rapid and complete irrigation of the bladder, the opening being large enough to evacuate most blood-clots and accumulations of pus.

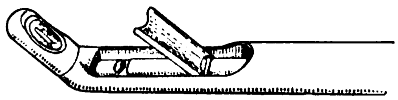


Fig. 44.—The Buerger catheterizing cystoscope with telescope in place.

2. It is not necessary to employ a catheter for previous washing of the bladder.

3. After withdrawal of the obturator, a right-angled prismatic telescope may be introduced and an examination of the entire bladder made, obtaining an unusually brilliant, large, and clear picture, and allowing of thorough meatoscopy before catheterism.

4. It is round and perfectly smooth, especially in the region of the beak, and its diameter at the angle where the beak joins the shaft is comparatively small, facilitating greatly the introduction of the instrument into the bladder.

There are no rough angles to injure the mucous membrane of the urethra.

5. The telescope may be removed without removing the sheath from the urethra, leaving the catheters lying perfectly free in a large metal tube, so that the sheath itself may then be easily removed with very little friction and less danger of pulling the catheters from the ureters.

6. The instrument is provided with an irrigating device so that the amount of distending fluid may be lessened or increased, at the will of the operator, without removing the instrument from the bladder; also, if the medium becomes cloudy from pus or blood, it may be rapidly changed without disturbing the patient.

7. The proximity of the lamp and objective lens gives the best illumination for catheterizing purposes.

8. There is no danger of burning the mucous membrane of the bladder with the beak of the instrument.

9. The catheter-bearing mechanism, being introduced after the sheath is in the bladder, never comes in contact with the mucous membrane of the urethra.

10. If the lens becomes soiled, it may be cleaned without removing the sheath from the urethra.

COMPOSITE CYSTOSCOPES

Using the same sheath, both Brown and Lewis have devised combination cystoscopes, Brown terming his "The Composite Cystoscope" and Lewis giving to his the name of "The Universal Cystoscope." Each has started with a sheath and obturator. An opening in the heel of the instrument allows of a direct-vision examining telescope

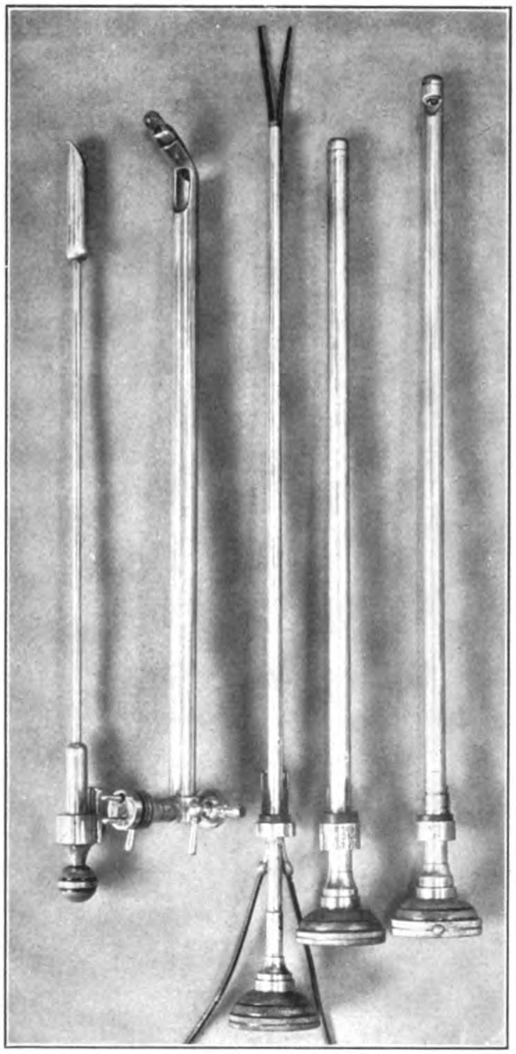


Fig. 45.—The Brown composite cystoscope, 1903 model, showing a doubly fenestrated sheath and interchangeable telescope.

and a direct catheterizing telescope. Fenestrating the anterior surface of the instrument corresponding to the concave angle formed by the beak and shaft of the instrument allows of the use of a telescope for indirect double ureter catheterism, a telescope for retrospective view, and an optic for right-angled examination (Figs. 47 to 58). Such complex instruments as these, however, are not to be recommended, for they are confusing, are not as technically perfect as those of simpler construction, and more easily get out of order. If one desires to use a direct catheterizing instrument, it is better to use an instrument which is constructed for that purpose alone.

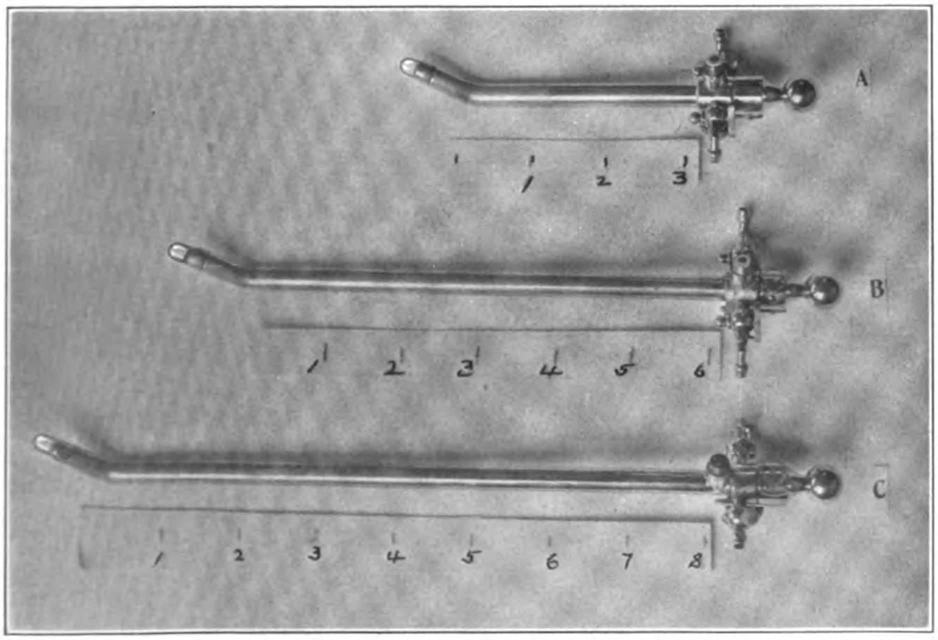


Fig. 46.—Three obturated cylindrical sheaths of as many composite cystoscopes of varying lengths among the earlier patterns of the Brown instrument, adaptable for different lengths of urethra.

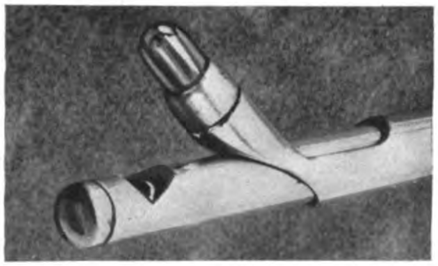


Fig. 47.—Beak (enlarged) of a composite cystoscope, showing lens of the indirect-vision telescope, shoved forward in the sheath well beyond the convexity fenestration, when employed distal to the lamp (Brown).

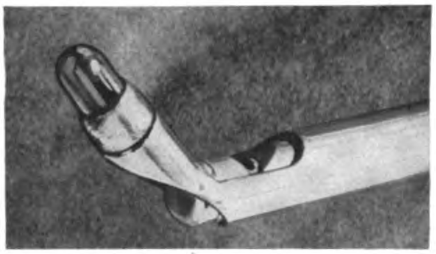


Fig. 48.—Beak (enlarged) of a composite cystoscope, showing lens of the right angle or retrograde telescope, as used in the concavity fenestration, proximal to the lamp (Brown).

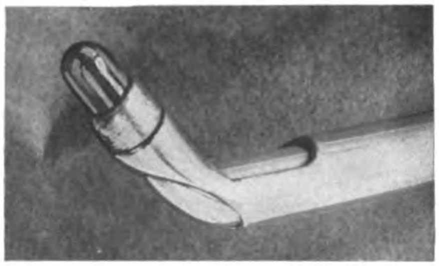


Fig. 49.—Beak (enlarged) of the composite cystoscope, to show the surfaces of the two fenestrations when filled by the obturator.

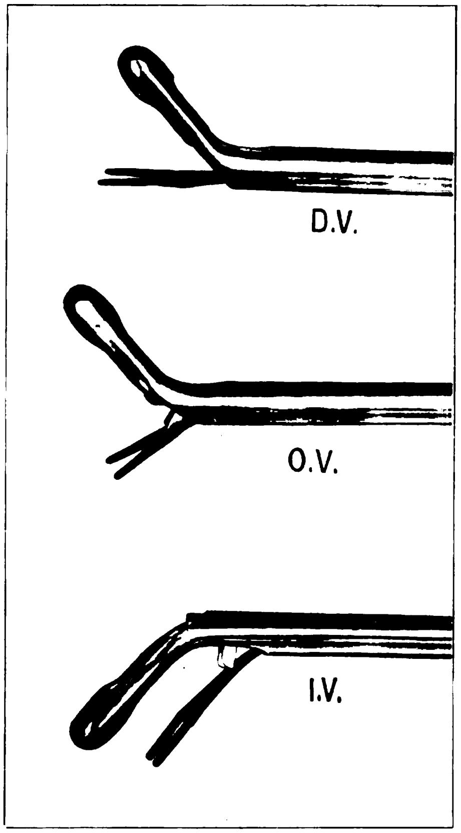


Fig. 50.—The Brown composite cystoscope, 1908 model: D. V., Direct view double catheter telescope in the sheath; O.V., oblique view double catheter telescope in the sheath; I.V., indirect view double catheterizing telescope in the sheath.

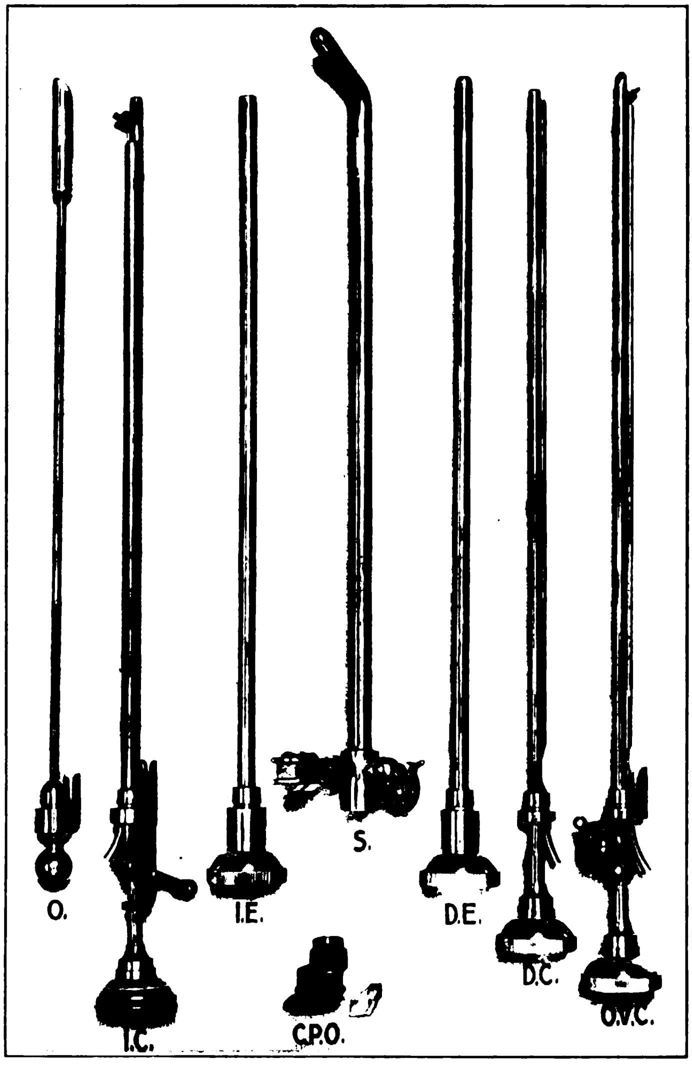


Fig. 51.—The Brown composite cystoscope, 1908 model: O., Obturator, I.C., indirect view double catheter telescope; I.E., indirect view examining telescope; S., sheath common to all telescopes, with inverted lamp, and having a fenestration at concavity and convexity; D.E., direct vision examining telescope; D.C., direct view double catheter telescope; O.V.C., oblique view double catheter telescope; C.P.O., compensating prism ocular.

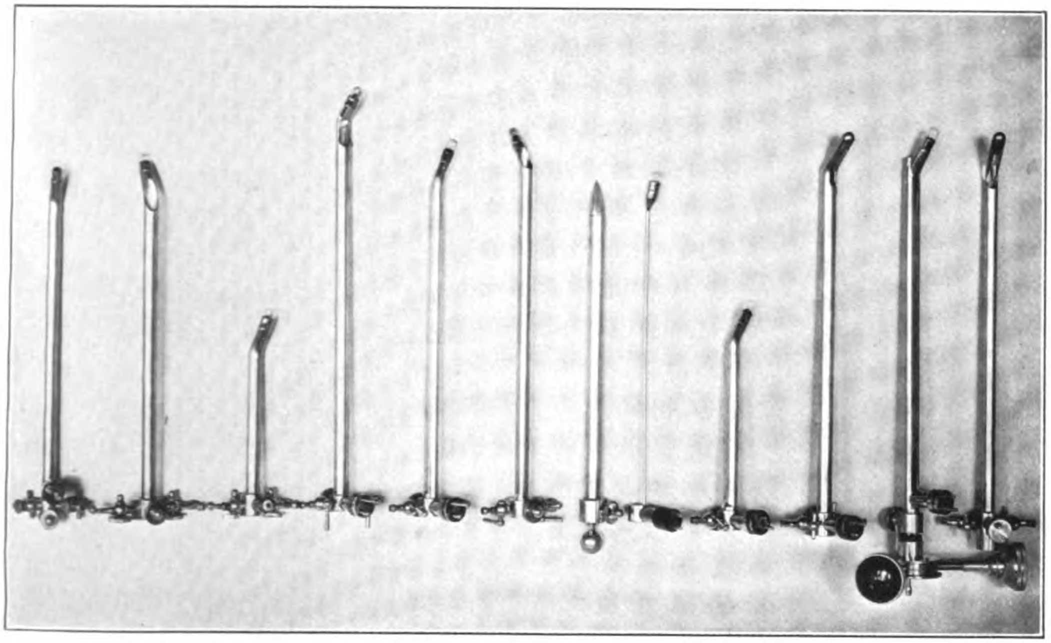


Fig. 52.—Assemblage of the various cold lamp-lighted sheaths belonging to the Brown composite cystoscopes.

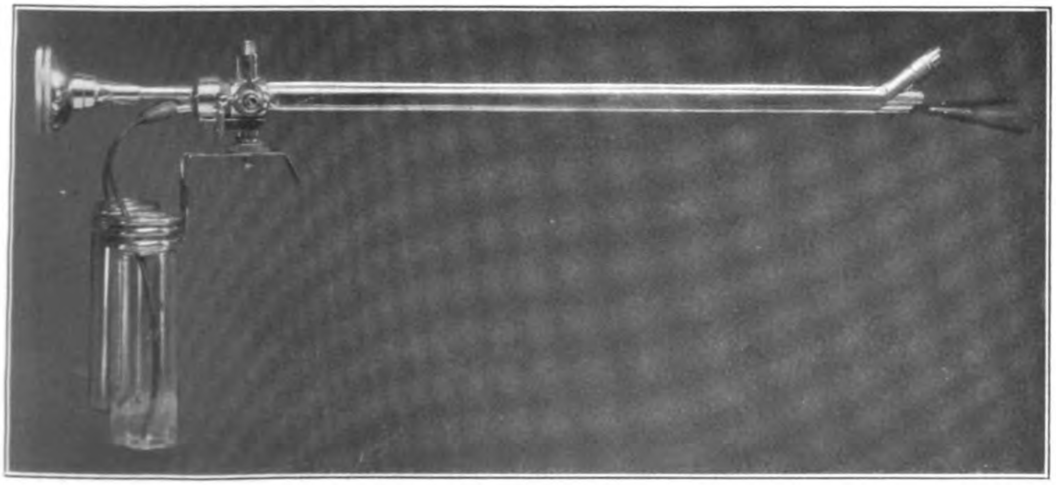


Fig. 53.—Lateral view of the composite cystoscope. Oval sheath, length 16.5 centimeters, circumference 26 millimeters, with a double catheter telescope in the sheath showing the approximate protrusion of the vesical lens beyond the end of the sheath, in order to bring it near enough to the lamp to take advantage of the best part of the illuminated field. A pair of screw-neck vials are shown suspended in the yoke, each holding a ureter catheter during urine collection.

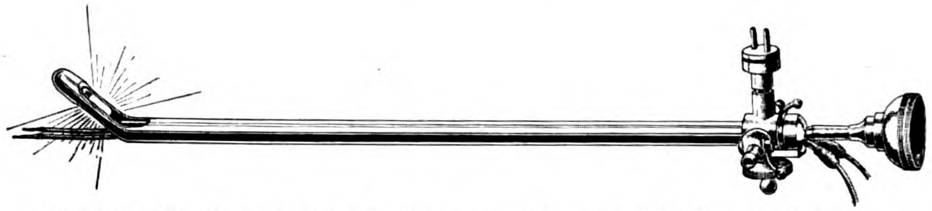


Fig. 54.—The Bransford Lewis universal cystoscope with telescope in place.

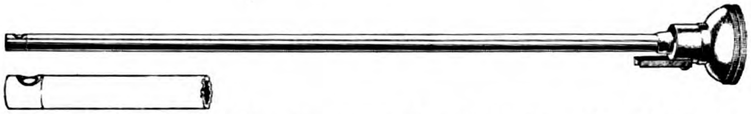


Fig. 55.—The Bransford Lewis universal cystoscope with right-angle and retrospection telescope.

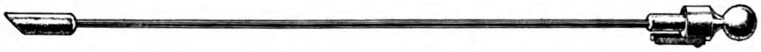


Fig. 56.—Obturator of a Bransford Lewis universal cystoscope.

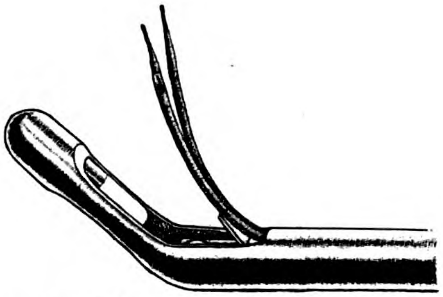


Fig. 57.—Indirect catheterizing arrangement for Bransford Lewis universal cystoscope.

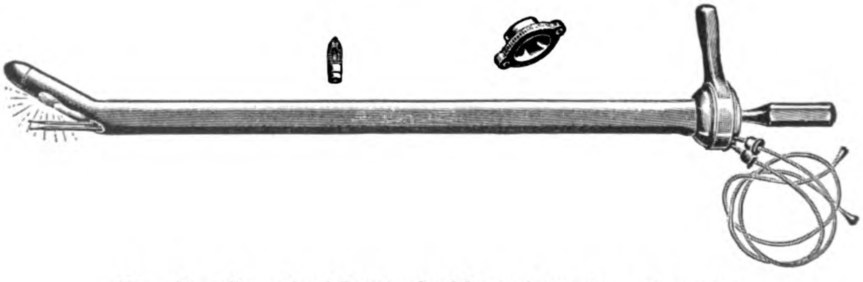


Fig. 58.—Bransford Lewis double male ureter cystoscope.

ENDOSCOPIC TUBES

The Kelly Endoscope.—The method of examining the interior of the bladder through endoscopic tubes has been employed by many operators, and in this country has been popularized by Howard Kelly, of Baltimore. His instrument consists of a set of endoscopic tubes of various sizes which are introduced through the urethra of the female with the patient in the knee-chest position. As soon as the instrument enters the bladder, air rushes in and dilates the viscus; then, using a reflecting mirror, a light is thrown through the tube, the ureter openings identified, and

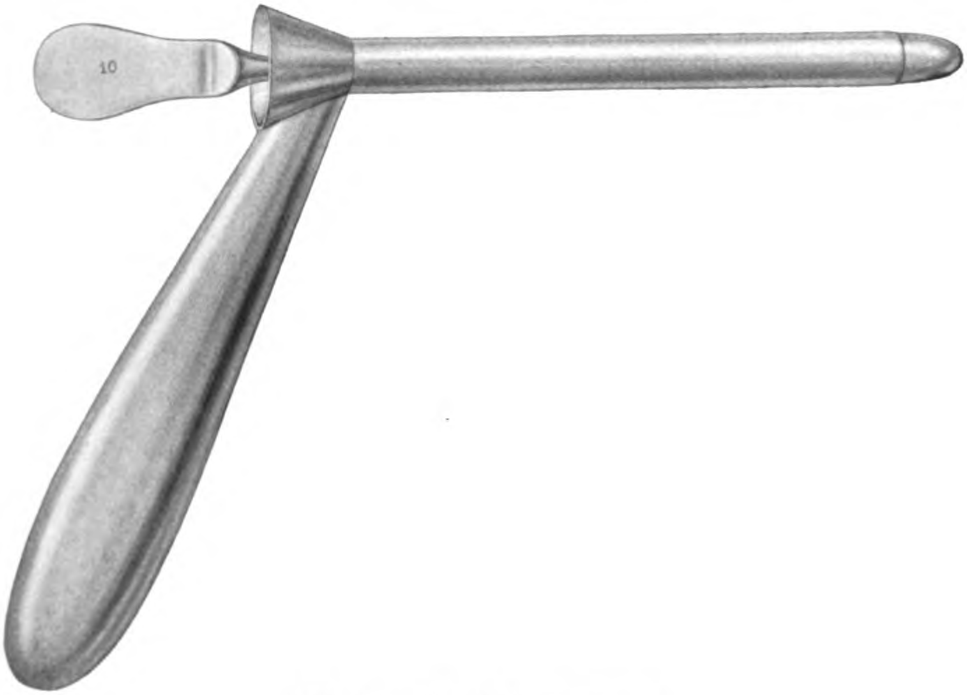


Fig. 59.—The Kelly endoscope.

catheters passed directly into the canals without touching the walls of the bladder.

The disadvantages of this method are:

1. That it is limited to female cases.

2. The position which it is necessary for the patient to assume is a disagreeable one and often is very tiring.

3. A general anesthetic is often necessary.

4. To the majority of operators it is a very difficult procedure.

Its advantages are:

1. That it gives a larger tube through which local applications may be made to the bladder.

2. It permits cleansing the ureter openings before inserting the catheter.

3. It allows introduction of the catheter into the ureter without first passing through a medium which is very possibly infected.

4. It also allows the use of a larger catheter and instruments for dilating the ureter and removing foreign bodies.

5. It allows of topical applications and minor operative procedures.

A still further advantage is that all of the instruments used in the manipulation may be sterilized by boiling.

Elsner and Braasch Cystoscopes.—The second type of endoscopic tube used for catheterizing is that which bears the name of Elsner. This instrument may be used either with air or water distention of the bladder. It is applicable in the male and consists of a sheath with a beak containing the lamp. In the floor of the hollow tube composing the instrument are contained two canals. In using the instrument, it is first introduced into the bladder with an obturator in place. This obturator is removed and a window of glass closes the proximal end of the instrument; then the viscus is filled with water or distended with air. With the light turned on, the ureter openings are searched for and, with a little practice, easily found; then the catheter is passed through the canal in the instrument and inserted into the ureter. The greatest disadvantage of this instrument is its very limited field of vision and its large caliber with an unusually long beak. However, it is used by some operators, and has the added advantage of a large open endoscopic tube which may be employed just as the Kelly tubes are in the female.

Dr. Braasch, of Rochester, Minn., has simplified and improved the Elsner type of cystoscope, and the new instrument which bears his name is recommended to those who prefer the endoscopic style of instrument.

PRACTICAL SUGGESTIONS IN EQUIPMENT

In advising the beginner as to what type of instrument will be most serviceable to him, the writer believes that an instrument such as that known as the Buerger-Brown cystoscope will be the most serviceable. It is an indirect irrigating, observation, and double catheterizing instrument, allowing a preliminary examination of the bladder with a prismatic telescope, giving a large field of vision; an instrument which allows of a free irrigation of the bladder without removing it from the urethra; an instrument which may be taken apart and thoroughly cleansed; is illuminated by a lamp of the cold type, and one which may be repaired in this country.

No operator, however, can be proficient in this branch of work unless he is familiar with the direct catheterizing instrument, for there are certain classes of cases in which it is only possible to catheterize the ureters with a direct cystoscope. In others it may be accomplished only by the use of an instrument of the indirect type. This would seem to argue in favor of so-called composite or universal instruments, but careful consideration of these does not recommend them to the writer.

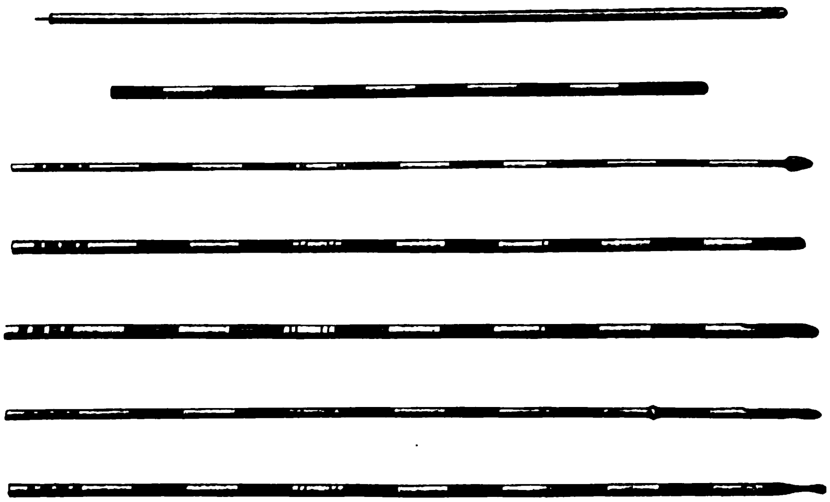


Fig. 60.—Showing different types of ureter catheters. These are mostly of French make, and the graduations are in centimeters so that the operator may measure exactly the distance a given catheter enters the ureter. Experience alone will guide the operator in his choice of catheters.

A complete equipment would consist of three cystoscopes—one, a simple examining cystoscope, No. 14 of the French scale in size; an American cystoscope of the type presented by Buerger, providing an indirect irrigating, observation, and double catheterizing instrument; and a third instrument, of the direct catheterizing type with a removable telescope, such as that devised by F. Tilden Brown, Bransford Lewis, or Braasch, or the modifications of Ayers and Cabot, of New York. This would provide a sufficient equipment to examine any but the most difficult and exceptional cases.

SEGREGATORS

A number of instruments have been devised for separating the urine from each kidney without the use of a ureter catheter. The object of the instrument is to provide a partition within the bladder dividing it into halves so that the urine from the right and left kidney will collect separately on each side of the partition, this urine then being collected by catheters from the bladder. The instruments devised by Harris and Luys are perhaps the two best known, but both of them are open to many objections. They are both very ingenious devices and undoubtedly in many cases, especially those of profuse hematuria, afford correct diagnostic data. Often it is necessary to use an examining cystoscope first to ascertain the cases which are suitable for the use of the segregator or separators. In such cases, is it not better to do all of the work with the instrument which gives us the most exact knowledge?

The *advantages* of this method are set down by Brown as follows:

1. The segregator may be used in either sex by any operator who is fairly experienced with sounds or catheters.

2. The instrument is not very expensive, is not easily injured, and can be thoroughly sterilized.

3. There is no danger of carrying infection from the bladder up into the ureters.

4. The collection of the two urines is synchronous.

The *disadvantages* of this method are:

1. The difficulty of passing the instrument into the bladder and the pain and risk of injury due to its manipulation and adjustment.

2. The position or presence of a foreign body cannot be ascertained.

3. The inability of obtaining uncontaminated urine for bacteriologic examination from the kidney.

4. The uncertainty of the entire procedure.

The writer feels that the separators have a very limited field of usefulness.

As to the relative safety of the separator and the cystoscope, I should say that the danger of infecting the ureter with the catheter is more an apparent danger than a real one. I have catheterized hundreds of ureters and in no case have I known of any injury or infection to follow the manipulation.

CHAPTER V

CARE OF THE INSTRUMENTS

Sterilization.—Everything which is to be used in a cystoscopic examination must be absolutely sterile. Unless this can be accomplished, and unless an examination can be conducted under aseptic conditions, it should never be attempted.

All metal and rubber instruments are first thoroughly cleansed mechanically with soap and water, great care being taken to remove all traces of foreign material. Rubber catheters and hollow instruments should have water under pressure forced through their lumen, and in the case of hollow metal tubes, when the caliber is large enough, they should be mechanically cleansed with stilets carrying pledgets of cotton.

The small catheter tubes which in the modern instruments are open for most of their extent may be cleansed by passing "pipe-stem cleaners" through them.

That part of the instrument which contains the lamp and lens should be treated as follows:

1. Thorough mechanical cleansing with soap and water, using a stiff brush, preferably a tooth-brush.
2. Washing off with a 5 per cent. solution of carbolic acid.
3. Injection of any enclosed tubes with 5 per cent. carbolic acid solution or 10 per cent. formalin solution, followed by alcohol.

4. Drying of all the parts with a clean towel. If there are any enclosed tubes, these should also be dried.

5. With all the parts separated, they should be placed in a formalin sterilizer (see Fig. 61), be exposed to the heated formalin vapor for two hours, and be allowed to remain in the sterilizer until used.

If it is necessary to use the instrument repeatedly without long enough interval for sterilization by formalin gas, the safest method is as follows:

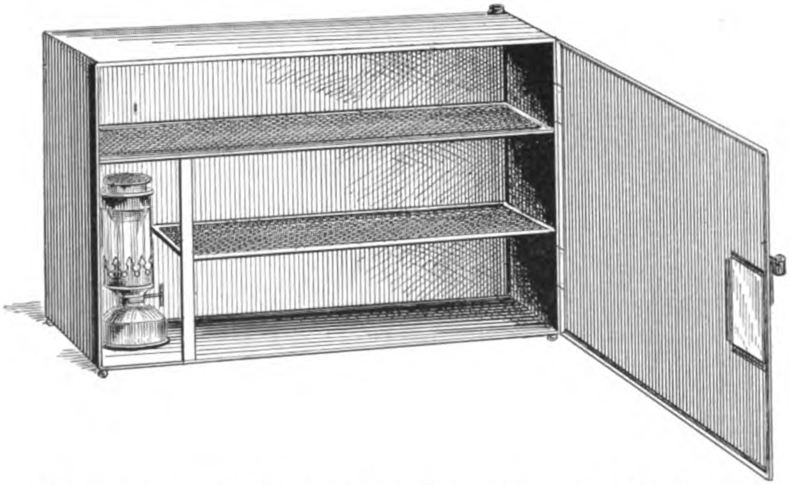


Fig. 61.—A formaldehyd sterilizer for instruments and catheters.

1. Thorough scrubbing with soap and water, and mechanical cleansing inside and out.

2. All metal parts excepting those containing lens systems and lamp to be boiled three minutes.

3. Telescope containing lens system to be immersed in 5 per cent. carbolic acid solution for ten minutes and then in 95 per cent. alcohol for one minute.

4. Sheath containing lighting system may be im-

mersed in 95 per cent. carbolic acid solution for one or two minutes and washed off in sterile water before using.

5. All parts may be kept in 5 per cent. carbolic acid solution until used.

Ureter Catheters.—After use each catheter should be thoroughly scrubbed with soap and water, and the lumen repeatedly flushed out with water. Then proceed as follows:

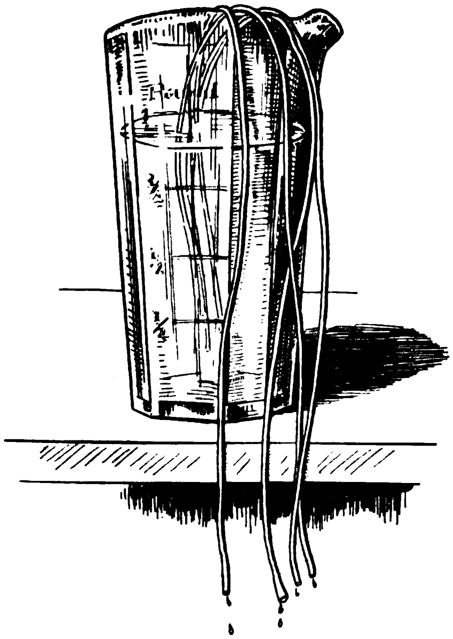


Fig. 62.—A method for the mechanical cleansing of ureter catheters. Water or an antiseptic solution is allowed to siphon through the small catheter for an hour or more, in this way mechanically cleansing the interior of the catheter.

1. Fill a pitcher with sterile water, and hang the catheters over the edge of the pitcher with the distal end of the catheter near the bottom of the pitcher and the proximal end hanging outside, reaching to a level lower than the

bottom of the pitcher, so that a siphonage will take place. Suck the catheter full of water, using a hypodermatic syringe, and the siphonage will start. The result is a mechanical washing out of the catheter for two to three hours, dependent on the amount of water used.

2. Flush out the catheter with a 10 per cent. formalin solution, using a hypodermatic syringe.

3. Place the catheter in the formalin gas sterilizer with the other instruments.

If it is necessary to use a catheter again the same day:

1. Scrub with soap and water.
2. Flush out with 10 per cent. formalin solution.
3. Flush out with 5 per cent. carbolic acid solution.
4. Boil for one minute in clear water, being sure that the water is boiling when the catheter is put in.

In every instance where a catheter has been used in a pus case it should be boiled before using again. This undoubtedly shortens the life of the catheter, but it lengthens the life of the patient.

The catheters should remain in an atmosphere of formalin while not in use.

A long straight glass tube is perhaps the best container for them.

No silk catheter should remain in an antiseptic solution for any length of time.

Soft rubber catheters are best sterilized by boiling for five minutes in a supersaturated solution of ammonium sulphate.

Lubrication of the Instruments.—The use of oil and vaselin in cystoscopic work is objectionable because the grease is deposited on the prism of the instrument and often obscures vision; and, also, it forms a coating over the mucous membrane of the urethra which retards the action of any local anesthetic which may be used.

Two lubricants are especially to be recommended:

Sterile Glycerin.—The method of using this is as follows: The anterior urethra is first irrigated with boric acid solution, and then the glycerin is injected into the urethra, using a sterilized one-ounce glass syringe for the purpose; the instrument is then introduced.

Katheterpurin.—This is the ideal lubricant. It is non-irritating, antiseptic, soluble in water, transparent, and will adhere closely enough to the instrument or catheter to insure its gliding gently over the mucous membrane. It is prepared as follows:

Hydrarg. oxycyanat	grs.	3½
Glycerini	drs.	5½
Tragacanth	grs.	46
Aquæ dest. sterilizat	oz.	3

The mixture is put up in tin tubes, and remains sterile eight days after being exposed to the air. As Casper states, it does not irritate the urethra, it makes the instruments exceptionally smooth and slippery, it is soluble in water, it does not act injuriously upon the cystoscope, it does not diminish the clearness of the picture, and can be put up in any form the operator desires. The operator will find it of advantage to lubricate the ureteral catheters before introducing them through the instrument.

SECTION II

THE CYSTOSCOPIC EXAMINATION

CHAPTER I

PREPARATION FOR A CYSTOSCOPIC EXAMINATION

PREPARATION OF THE PATIENT

No cystoscopic examination should be undertaken without due preparation on the part of the patient. In the most simple form of examination, that of a non-irritated female bladder, there are many things which will add to the ease and thoroughness with which the examination may be conducted. If possible, the patient should be prepared for anesthesia, should receive a hot tub bath, and have the lower bowel emptied, preferably by enema. This last detail is especially important, as a number of cases have been presented to the writer for examination in which the rectum was so impacted with feces that even the introduction of a cystoscope into the bladder was difficult. It is well to give the patient plenty of water to drink in order to increase the amount of urine; at the same time omit all medication in order that the chemical examination of the urine may not be misinterpreted. When a severe cystitis exists, the bladder must receive appropriate treatment for a number of days previous to the examination. In hemorrhagic cases it is often necessary to confine the patient to bed for a week or more before a good inspection of the bladder can be made.

Male Patients.—It is essential to know whether or not the male urethra is of sufficient size to allow the passage of the cystoscope. In order to determine this, sounds may be passed, using graduated sizes up to No. 26 of the French scale. It will sometimes be found that the *meatus urinarius* is too narrow to allow this, and under such circumstances a meatotomy should be done under cocain. Strictures, if encountered, should be dilated. A rectal examination should be made to determine the size of the prostate. Although the prostate may not seem large, still it may so obstruct the urethra that it is impossible to pass a cystoscope.

Female Patients.—It is always well to have a vaginal douche given. Shaving of the parts is not necessary. Special indications will be considered later.

It is better to make a thorough examination of the patient on the day preceding the cystoscopic examination and have a twenty-four-hour specimen of urine collected and examined. Some patients need sedatives, and the bromids or morphin may be exhibited without influencing the findings.

In patients who have no pus or blood in their urine, the urine may be used as a medium for the examination. If this is to be done, the patient is instructed to hold the urine for three or four hours before examination.

The patient is dressed as for any pelvic examination. All clothing which constricts the abdomen should be removed. The arrangement of the sheets or leggings and sterile towels is left to the individual operator.

PREPARATION OF THE ROOM, INSTRUMENTS, AND ACCESSORIES

In Hospital Work.—The conditions which are found in a well-equipped hospital are ideal for conducting a cystoscopic examination. The requirements are a clean room, a clean operator, and clean instruments. The best table to be used is one which can be adjusted in various positions so that the pelvis of the patient may be raised and lowered without disturbing the patient (Fig. 63). It

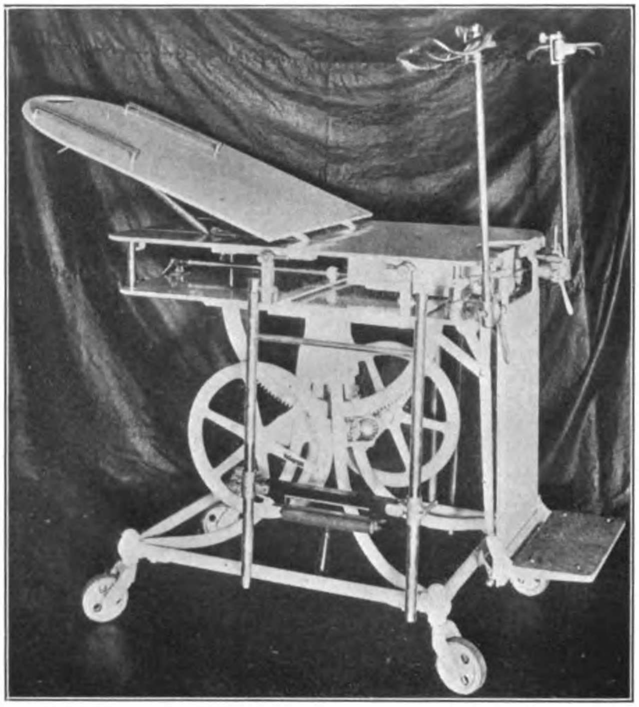


Fig. 63.—A table suitable for cystoscopic examinations (Brown).

is also essential that proper leg supporters be attached so that the patient may be as comfortable as possible during the operation. The most suitable leg supporters are those in which the knee rests in a semi-flexed position, in a double inclined conical gutter.

The patient is placed on his back on the table, the thighs are flexed, and the knees held in a semi-flexed position, resting on the leg supporters. The buttocks of the patient should be brought to the very edge of the table. In most cases it is better to have the pelvis on a higher level than the rest of the body. A pillow is placed under the head.

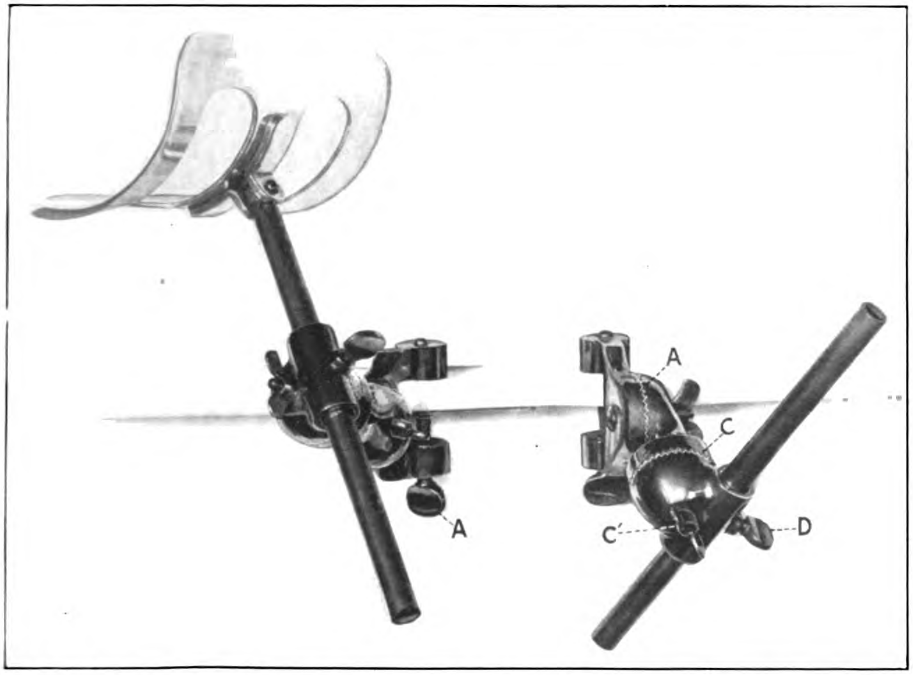


Fig. 64.—Adjustable leg supports devised by F. Tilden Brown.

If the operator is working without an assistant, it is

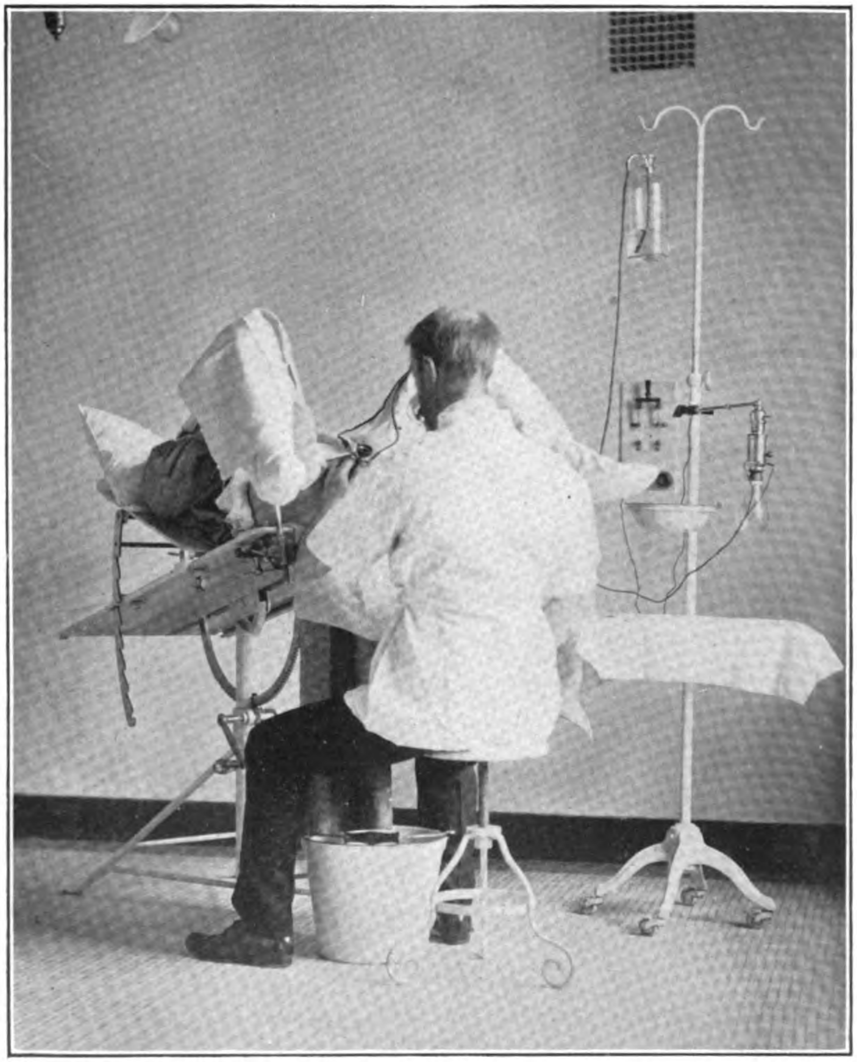


Fig. 65.—Patient, operator, and tables in position for a cystoscopic examination (Brown).

essential that everything which is to be used in the examination be within easy reach. For convenience, a relatively large table is placed at the right hand of the operator, and on it is placed everything which may be needed. Ordinarily an assistant is present, and then a second table may be used, placed so that it is within easy reach.

An irrigating stand with the usual attachments is a great convenience, but by no means a necessity. We have found that a large four- or five-ounce glass syringe is more useful and safer for irrigating and filling the bladder than an irrigation jar and tube.

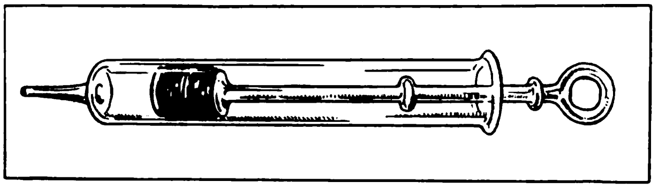


Fig. 66.—A four-ounce glass syringe for irrigation purposes. These may be obtained from Whitall Tatum Company, New York City.

It is necessary to provide a suitable battery, or controller, so constructed as to be easily controlled by the operator. As previously stated, an eight-cell dry battery with rheostat is the best. This must be thoroughly tested before the cystoscope is introduced into the bladder.

What the Nurse Should Prepare.—A great deal of time will be saved if the nurse or assistant is properly instructed as to what preparations are to be made. The nurse is to prepare the table for the patient, and arrange the instrument table, placing on it a jar containing 5 per cent. carbolic acid, a vessel containing sterile water or

2 per cent. boracic acid solution, a sterile sheet for the patient, some sterile towels, a number of sterile pieces of gauze, two sterile medicine glasses, a four-ounce glass syringe, and a measuring glass for the urine. Also, the following instruments: 2 hypodermatic syringes, a pair of scissors, a pair of anatomic forceps. If the male bladder is to be examined, a set of sounds should be provided, and a small glass syringe for injecting cocain solution; also a Murphy syringe for dilating the renal pelvis.

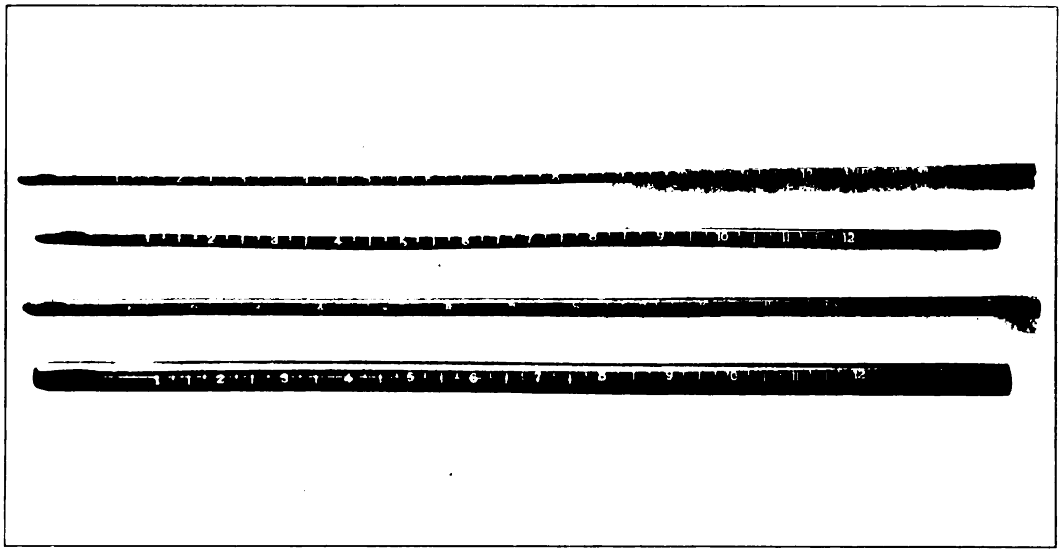


Fig. 67.—The various types of catheters used in an examination of the urethra and bladder (Brown).

The Instrument Sterilizer.—If the small formalin sterilizer, as previously described, is used, this is brought into the operating room and left closed. It contains the cystoscopes and accessories, and the ureter catheters.

Rubber Catheters.—It is well to provide three or four sterilized rubber catheters, contained in a sterile glass cylinder. For female cases a short rubber catheter may be used.

Tray for Accessories.—The nurse is to prepare a tray with a test-tube rack, supplied with at least six sterile test-tubes. The cocain solution, lubricants, a 10 per cent. solution of silver nitrate, a bottle of cocain crystals, 1⅛ grain alypin tablets, indigo-carmin tablets, and any other solution which the individual operator may desire, are placed on this tray.

What the Operator Attends to.—After scrubbing up, he sees that all the necessary parts of the cystoscope and attachments are provided. He tests his battery and the electrical attachments to his instrument, and forces some solution through the ureter catheters to insure their being open.

PREPARATION FOR AN OFFICE EXAMINATION

For ordinary cystoscopic examination of the bladder at the surgeon's office, the arrangement should be as simple as possible. All instruments and accessories to be used are sterilized. Provide a jar of 5 per cent. carbolic acid solution for holding the cystoscopes; a basin containing sterile water or boracic acid solution; glass syringe and sterile catheters; test-tubes for collecting the urine; hypodermatic syringe; battery.

Unless a surgeon has a special examining room in addition to his consulting room it is rather dangerous to attempt ureter catheterism. A simple examination of the bladder, however, is no more complicated than the passage of a sound and can be done anywhere.

If the urine is clear, the examination may be conducted without washing out the bladder, it being best that the patient retain his urine for at least two hours. With

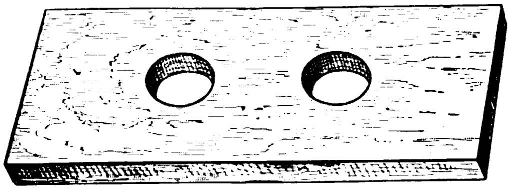


Fig. 68.—Wooden piece cut for holding cystoscopes.

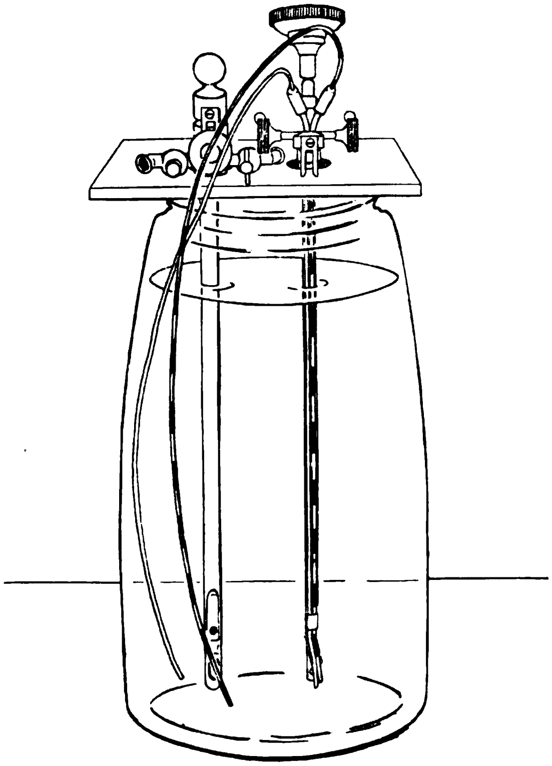


Fig. 69.—Jar of solution with wooden piece and cystoscopes ready for use.

the patient in the lithotomy position, cocain is injected into the urethra, or cocain crystals are inserted into the *meatus urinarius*, and, without any further manipulation, the cystoscope is introduced into the bladder and the light turned on. In the majority of cases, unless there is considerable pus or blood present, this is all the manipulation necessary to make a thorough examination of the bladder. When it is remembered that some men of very extensive experience never use the ureter catheter, but depend entirely upon the cystoscopic and meatoscopic examination of the bladder for their diagnosis of both renal and bladder conditions, one can easily see that if no more manipulation or preparation is necessary than the mere introduction of an instrument into the bladder, the cystoscope will come more and more into general use, and there will be fewer mistakes in diagnosis.

PREPARATION FOR AN EXAMINATION AT THE PATIENT'S HOME

What the Family Should Prepare.—Clean towels, slop jar, two wash-bowls, two pitchers of boiled water—one hot and one cold, clean sheets, a wash-board or table leaves to put under the mattress of the bed; a fountain syringe which has been boiled, rubber sheeting, a kitchen table, hammer and tacks. If the patient is confined to the bed, it may be necessary to make the examination with the patient in the lithotomy position lying cross-wise on the bed. The examination will be more facile, both for the surgeon and the patient, if the patient is placed upon a suitable table, even if it be simply an ordinary kitchen table. If this be not feasible, a successful examination may still be made if the patient is brought to the edge of the bed and there supported by a proper board slipped under the pelvis.

What the Operator Should Take with Him.—The operator should always take with him more than one cystoscope. Personally the writer prefers a direct catheterizing cystoscope, an indirect catheterizing cystoscope, and a small caliber examining cystoscope. Such a combination is very much to be preferred to any of the composite or universal instruments on the market, and does not cost any more. The operator should also take with him sounds, rubber connecting tubes, cocain crystals, alypin tablets, a bottle of cold sterile water, a tube of lubricating jelly, a battery and connecting wires, ureter catheters, test-tubes, cotton, measuring glasses, medicine glasses, and a 10 per cent. solution of silver nitrate.

ARRANGING THE ROOM FOR AN EXAMINATION

It is essential that everything be prepared before starting the examination. The cystoscope, and other instruments, as well as the irrigating solution, must be within easy reach of the operator. One assistant is all that is necessary for a thorough examination, and he stands to the left of the operator. The arrangement of the table and stands has been previously described.

CHAPTER II

CONDUCTING AN EXAMINATION

Placing the Patient in Position. The Lithotomy Posture.—First, for examining the bladder in the male or female with the lens cystoscope, the best position is the so-called lithotomy position with the patient on the back, the pelvis elevated, the thighs separated and flexed, and the knees bent and raised in grooved supporters. It is desirable that the table shall be so constructed that the pelvis of the patient may be raised or lowered at the will of the operator. This is especially the case in hydronephrosis when the catheter has been passed as far as the renal pelvis. It has happened to the writer that with a patient lying on her back no urine has escaped by way of the ureter catheter until the patient was raised to a sitting posture, when the urine from the pelvis of the kidney emptied itself very rapidly. It is advisable, therefore, in hydronephrosis to change the position of the patient and to advance the catheter as far as the renal pelvis.

The Knee-Chest or Sims Posture.—In using open endoscopic tubes, it is necessary to dilate the bladder by means of air. The patient assuming the knee-chest posture or exaggerated Sims posture, the endoscopic tube is introduced into the urethra, the obturator is removed, and air enters and dilates the viscus.

Anesthesia.—In the great majority of cases no anesthetic is necessary, but when the urethra is irritable or where severe inflammation of the bladder is present, some form of anesthetic is called for. This is especially true in the case of tubercular inflammation. In nervous patients, a suppository of antipyrin and opium, or a solution containing chloral may be introduced into the rectum half an hour before the examination. This will greatly relieve the patient and will also increase the bladder capacity. A hypodermatic injection of morphin or the exhibition of

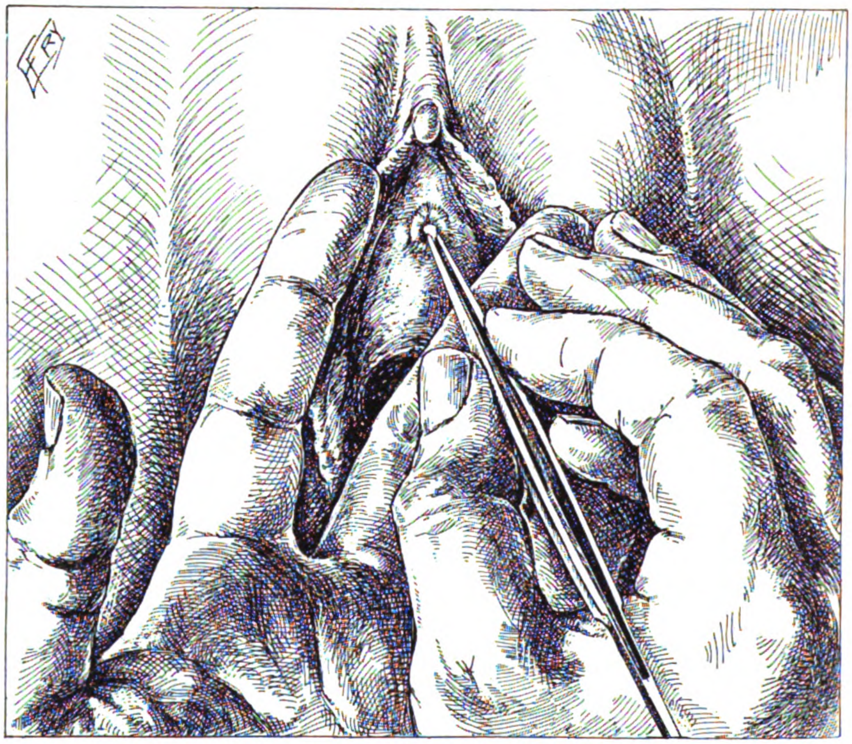


Fig. 70.—Method of anesthetizing the external meatus in women before making a cystoscopic examination. Alypin tablets or powder may be deposited in the urethra.

the bromids by mouth is sometimes necessary in extremely nervous people. It will be found that the most sensitive portion of the urethra in women is at the external meatus, so that, in general, in examination of the female bladder, this portion of the urethra should be thoroughly anesthetized, using the method shown in Fig. 70. In men, the external meatus and the prostatic portion of the urethra are the most sensitive; the most effective method of anesthetizing the male urethra is by applying a 4 per cent. solution of novocain on a cotton swab to the first two inches of the urethra, removing it after four or five minutes. We have discarded the use of cocain in the urethra on account of the occasional fatality which has followed its use. In this way the first inch of the urethra is anesthetized and meatotomy may be done if desired. A hollow Lewis applicator (as shown in the accompanying illustration, Fig. 71) is then passed to the posterior urethra, the obturator removed, and two tablets of alypin are dropped in. The obturator is again introduced, the tablets being pushed ahead of it, and the instrument removed, leaving the tablets to dissolve

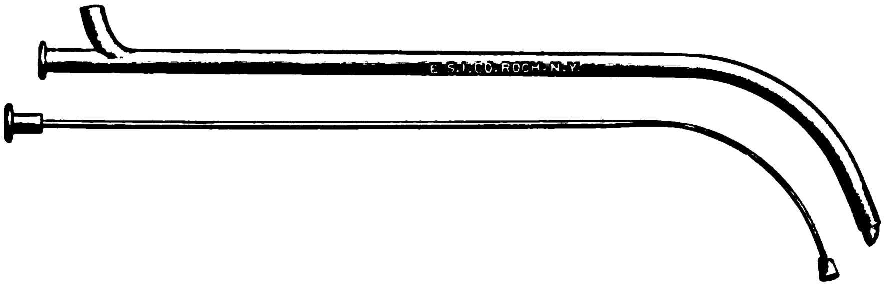


Fig. 71.—The Lewis applicator for depositing pellets in the prostatic urethra of the male.

in the urethra. The tablets dissolve slowly and are not as toxic as cocain. No poisoning has ever been reported from the use of alypin. For anesthetizing a sensitive bladder a 2 per cent. solution of novocain may be injected, but it should be avoided if possible. In tuberculosis of the bladder it is seldom possible to make a complete examination without the use of a general anesthetic, and one should not hesitate to employ it if necessary.

Preparation of the Bladder.—When the urine is clear or only mildly cloudy, there is no more satisfactory medium for examination of the interior of the bladder than the urine itself. If it can be used it very greatly simplifies the technic and avoids the traumatism of irrigation. The patient is instructed to retain the urine for at least two hours, and no further preparation is necessary.

Water as a Dilating Medium.—Water, or a 2 per cent. boric acid solution, is almost equal to urine in its non-irritating effect upon the bladder. It is a natural medium, is well borne by the patient, and may be introduced at a proper temperature. The only essential is that the solution shall be sterile and not too cold or too hot. The bladder seen through such a medium appears in its normal state, with the exception of the fact that the mucous membrane reflects somewhat the brilliancy of the lamp, and, therefore, is whiter than normal. If papillomata are present, the seaweed-like projections float freely in the water and can easily be seen, while with air distention these outgrowths lie flat against the bladder mucosa. A fluid medium is also important since it allows one to estimate accurately the distensibility of the bladder.

Air as a Distending Medium.—Air is not a natural medium for the bladder, and causes considerable discomfort, necessitating the use of anesthetics locally. There are certain cases of profuse hemorrhage in which a fluid medium cannot be used, and under such circumstances air is indicated, but we do not recommend it.

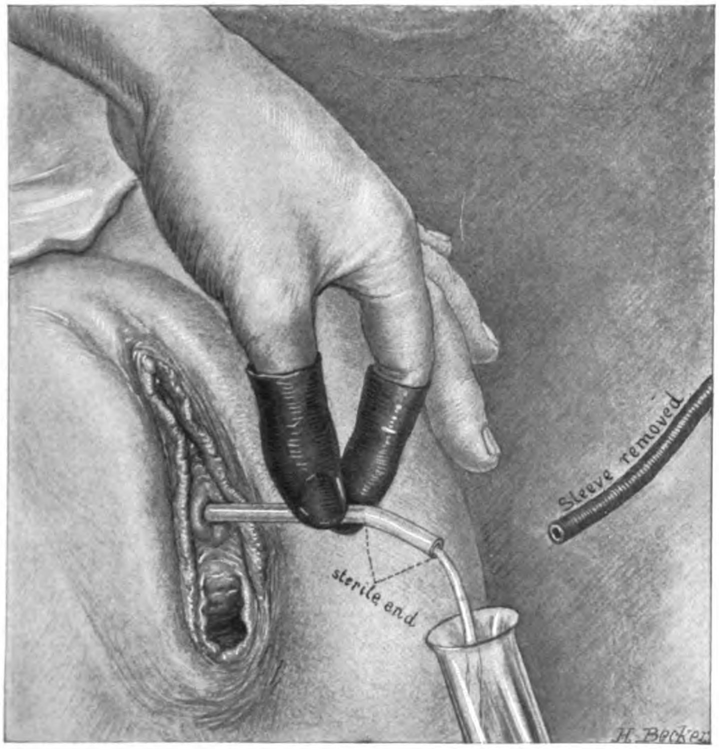


Fig. 72.—Collecting urine from the bladder for examination. Great care must be taken to avoid contamination of the urine if a bacteriologic examination is to be made (Kelly).

Urine as a Medium.—When no pus, blood, or other foreign matter has been found in the urine, the cystoscope may be immediately introduced and the examination made.

Steps of the Examination.—If it is necessary to use a foreign medium for the examination, the patient is instructed to pass as much urine as possible, then a soft-rubber or silk catheter is introduced and the residual urine is collected and saved for further examination. The use of metal catheters should be avoided if possible. Then using a hand syringe, four or five ounces of sterile water, or of a 2 per cent. boric acid solution, are introduced into the bladder and allowed to flow out, being received into the measuring glass. The amount and character of the return flow is noted. If fairly clear, five ounces more of solution are introduced and left in the bladder. If the solution is still cloudy, wash the bladder continuously until it is clear. It is not necessary and often detrimental to use large amounts of fluid in irrigating the bladder. The quickest results will be obtained from using not more than five ounces, and each time leaving a small amount in the bladder. The irrigation should be continued until the fluid returns fairly clear and colorless.

A number of valuable facts can be learned from this procedure. If the medium clears after a single washing, it is probable that the pus is secreted from the ureter or kidney. If the bladder is not cleared after repeated washing, it is almost positive proof that at least most of the pus is secreted within the bladder. If, after the medium has come away clear, it again suddenly becomes cloudy, it is suggestive of pockets or diverticula in the bladder which have emptied themselves after the bladder has been cleansed, or else a fresh supply of pus has been emptied from the ureter or kidney. In chronic cystitis the length of time it takes to clear the fluid depends on many factors. Sacculated bladders and those containing large diverticula or connecting with abscess cavities are most difficult to handle. Where alkaline urine has been present for a long time the walls are frequently thickly studded with sabulous, mucopurulent collections which demand much patience to clear away. In some cases, it is impossible to clear the medium sufficiently to make a satisfactory examination.

If Blood is Present in the Urine.—The presence of blood in the bladder makes cystoscopy difficult. If, after a single washing of the bladder, the medium clears, it is probable that the bleeding does not originate in the bladder. If the posterior urethra is injured, the blood usually flows back into the bladder, quickly obscuring the medium. If the bleeding comes from an ulceration of the bladder or a papillomatous growth, repeated washing often exaggerates the bleeding. If from the mucous membrane of a previously distended bladder, the bleeding is generally so severe that examination is impossible. If from a cystitis, the oozing is usually slow and a satisfactory examination can be made. If from a point above the bladder, the medium can be quickly cleared and the oozing of blood from the ureter opening, or its mixture with the urinary efflux, can be quickly determined.

In preparing the bladder for examination in the presence of a hemorrhage from the bladder wall, it is advisable not to entirely empty the bladder, but to leave at least an ounce of fluid behind; then the walls of the bladder do not come together and excite renewed hemorrhage. This will probably take place most often in the presence of a rough stone or new-growth. It is occasionally seen in chronic cystitis. If both blood and pus are present in the urine the same precautions are necessary as above described.

Amount of Fluid to Leave in the Bladder.—For a satisfactory examination of the bladder in the male, at least 150 c.c., or about 5 oz., of fluid should be left in the bladder, and fully an ounce more, if possible, in the female. About one ounce and a half is the least quantity that may be used successfully. One of the first things for a cystoscopist to appreciate is that the picture presented by a bladder greatly depends upon the amount of solution contained within it. In preparing the bladder for examination it must be remembered that the fewer the manipulations employed, the better will be the results. This is commented upon elsewhere.

Management of Difficult Cases.—The inflamed bladder and the irritable bladder are often difficult to examine. In the former it is best not to force the examination too far, or serious injury may result. In conditions of acute cystitis, cystoscopy should not be attempted, but when the irritation originates outside of the bladder, local anesthesia and sedatives often will make an examination possible. In the cases of irritable bladder the difficulty originates from muscular spasm which can usually be controlled by morphin or opium suppositories.

Contracted Bladder.—The contracted bladder must receive preliminary treatment, and when its capacity reaches 50 c.c., an examination can be made. In some cases using the Pilcher close view cystoscope it is possible to make an examination with a smaller amount of distending medium.

Dilated Bladder.—If the bladder has been distended it is possible to make an examination with a large amount of medium, and it may be remarked, in passing, that the most thorough examinations of the bladder are made with the larger amounts of fluid.

The Intolerant Bladder.—Nothing is more exasperating than attempting cystoscopy in the presence of intolerance. I have found that a most satisfactory way is to cocainize the bladder and then use an indirect irrigating cystoscope, allowing the water to flow in, making a rapid systematic examination with a running stream passing through the bladder.

The Incontinent Bladder.—The Braasch cystoscope is perhaps the most satisfactory for use in such cases. While using this instrument the water is continually running into the bladder and is flowing out through the irrigating tubes. Even where there is almost complete incontinence, it is possible to make a thorough examination of the bladder.

A Persistent Cloudy Medium.—Frequently we meet with cases where the bladder is so foul or its surface so sensitive that a clear medium cannot be produced. We then have to use air as a distending medium, or else treat the bladder for a considerable length of time until it is possible to prepare it properly for examination.

Essentials for a Successful Examination.—1. Sterile instruments, an aseptic technic, and a patient operator.

2. A urethra of sufficient size to allow the introduction of the cystoscope.

3. A clear, non-irritating medium.

4. A dilatable bladder which will contain more than 50 c.c. of fluid.

5. A good illumination.

Testing the Instruments.—Before commencing any examination the cystoscope should be thoroughly inspected and all parts accounted for and tested to make sure that they are in good working order. The lenses should be looked through and properly polished. All stop-cocks should be turned to make sure that they are free. The ureter catheters should be tested by forcing water through their lumen and then inserted into their place and the washers adjusted. The lighting system should be tested and the current adjusted so as to produce sufficient illumination. If the lamp fails to work, use the following tests:

1. Test the source of electricity, the battery or rheostat, by attaching another instrument.

2. Test the connecting cable by substituting another cord.

3. Remove the lamp from its socket and see that the contact wire is long enough to touch the disk in the center of the socket of the shaft. The lamp may also be tested by attaching it directly to the poles of the battery.

4. If the instrument itself is short-circuited, this will be shown after it has been demonstrated that the battery, cable, and lamp are perfect, and still no light appears when the instrument is attached.

The fault is generally with the contact point, either where the lamp is attached in the socket or where the cord from the battery is attached to the instrument, and therefore, all metal parts which are used in the contact should be kept bright.

Introduction of the Cystoscope.—In the male, the small examining cystoscope of the Otis or Nitze type is introduced in the same manner as a sound. It is often helpful to place the hand on the perineum and as the

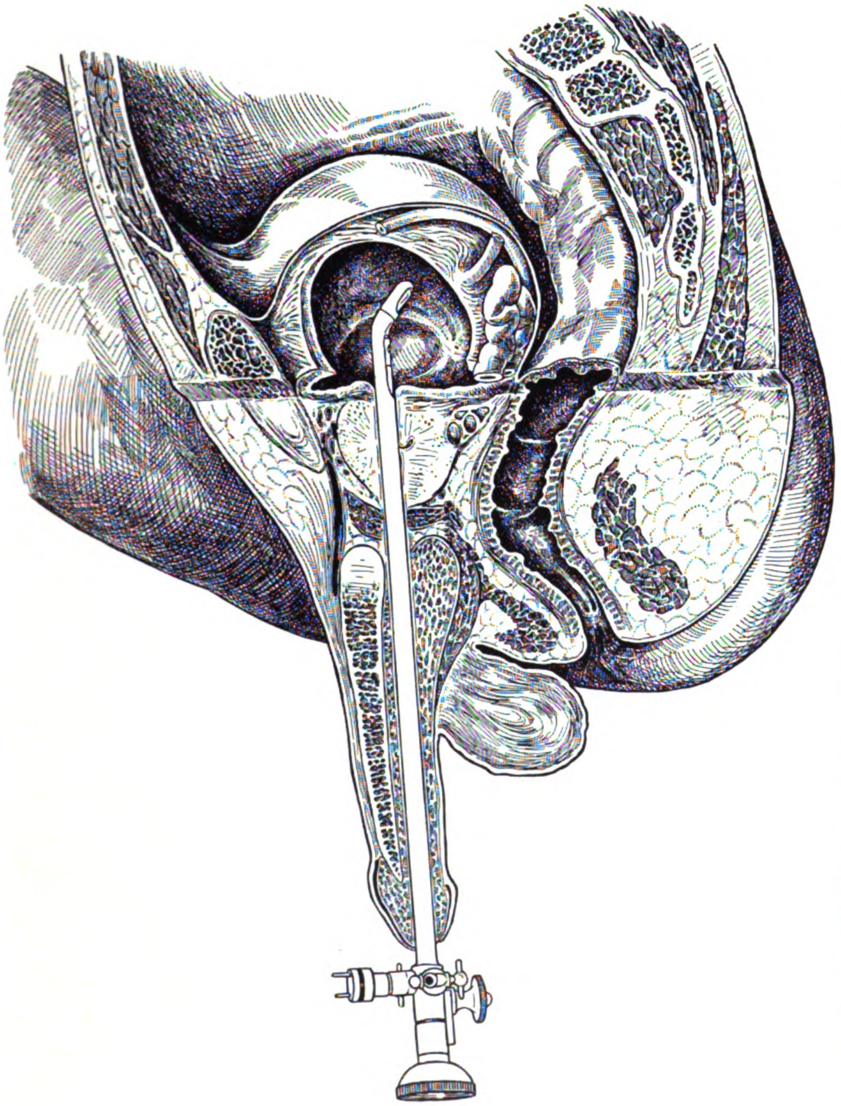


Fig. 73.—Position of the cystoscope in the male and its relation to the various structures.

instrument reaches the posterior urethra the tip of the instrument is lifted up as the ocular end is depressed. In introducing the catheterizing cystoscope it is done with the obturator in place. One who is familiar with the introduction of the sound into the bladder will find no difficulty in the manipulation of this instrument.

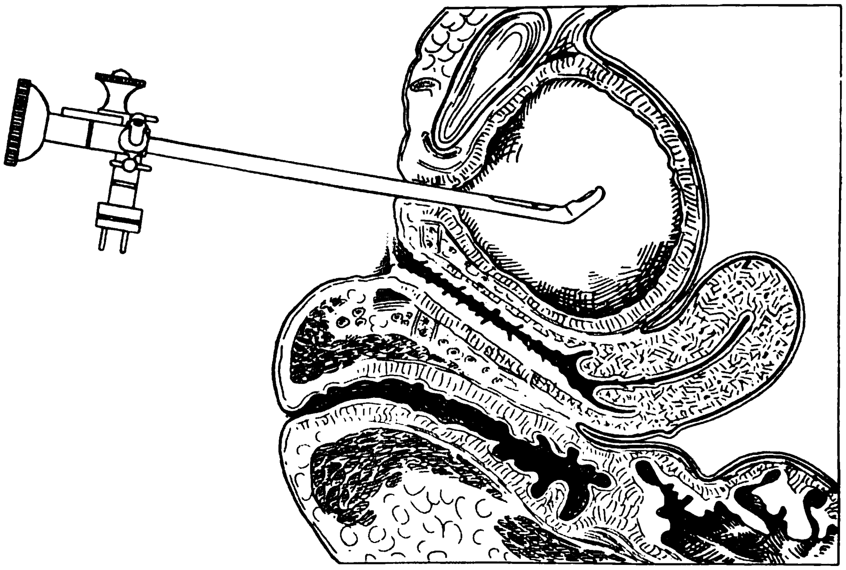


Fig. 74.—Position of the cystoscope in the female. It can easily be seen from this illustration how a prolapse of the uterus would encroach upon and cause pressure upon the trigone of the bladder; also how a rectum full of fecal matter would embarrass a cystoscopist in his examination. The vesicovaginal and urethrovaginal septum is relatively much thinner than is here shown.

When the instrument is in the bladder it will be found that the beak can be moved from side to side without any trouble. The normal length of the male urethra is about nine inches; in those suffering from hypertrophy of the prostate the length of the urethra is considerably increased.

Reasons for Failure to See Anything.—1. The lamp or lens may be hidden. This occurs when the instrument is advanced too far into the bladder (Fig. 75), the lamp impinging on the opposite wall; or the bladder may be sacculated, and the lamp or lens hidden in one of the sacs, or the lens may be in the urethra, as shown in the accompanying illustration (Fig. 76).

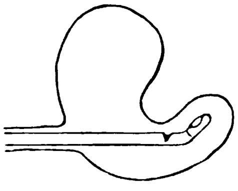


Fig. 75.—Cystoscope advanced too far into the bladder.

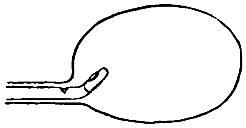


Fig. 76.—Cystoscope not advanced far enough into the bladder.

2. The lens may be smeared with blood, pus, or other tissue.

3. The bladder may be empty, the fluid having escaped.

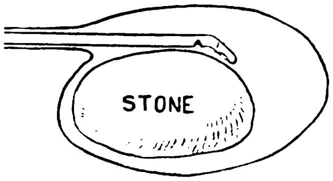


Fig. 77.—Cystoscopic examination made difficult by the presence of a large stone in the bladder.

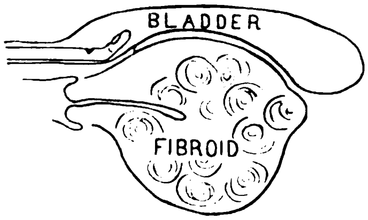


Fig. 78.—Extravesical tumor encroaching upon the bladder.

4. Light may fail to work, due to causes already described.

5. The most frequent cause is that the medium has become cloudy, due to the presence of blood or pus.

6. It is frequently found that in acute cystitis the mucous

membrane is intensely swollen and non-reflecting, so that the surface cannot be clearly seen.

7. It may be that the lens or lamp is held too closely against the object to be viewed. This often happens when large stones are present in the bladder (Fig. 77), when intravesical tumors fill the bladder, and when a pregnant uterus presses against the bladder.

8. When the beak of the instrument is surrounded by a tumor mass (Fig. 79).

Aside from these causes, there are many difficulties which arise, and, although there is plenty of room within the bladder, still the operator is not able to see anything. In the first place, many beginners do not look through the telescope directly, and although the picture is sufficiently illuminated they cannot see it. Again, the instrument may be manipulated so that an object is out of focus or is blurred. All of these things can soon be corrected by practice. If one cannot see clearly the bladder picture, he should change the position of his instrument, either advancing or withdrawing it, turning it from side to side, or revolving the shaft of the instrument.

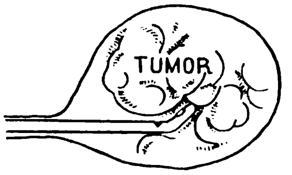


Fig. 79.—Intravesical tumor with beak of cystoscope engaged in it.

CHAPTER III

OBSERVATION AND ORIENTATION OF THE BLADDER

Each operator should adopt for himself a routine method of examining the interior of the bladder. In my own work, I begin by making an examination of the vesical neck, noting any irregularities or changes in the character of the mucous membrane. Then, in turn, I examine the anterior surface, the superior surface, the lateral walls, the posterior wall, and, finally, the trigone and ureter openings. In cases of hematuria, this routine is reversed, and the trigone and ureter openings are examined first, before the medium becomes obscured.

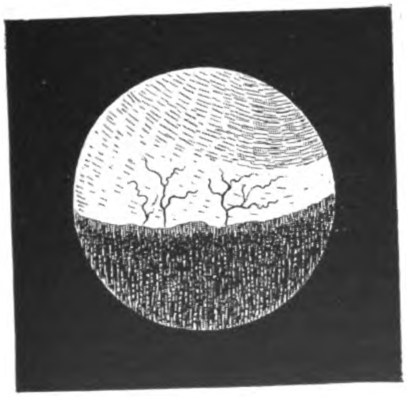


Fig. 80.—Cystoscopic picture of a normal urethral border.

The Vesical Neck.—Normally, in both sexes, the point of transition from urethral to vesical mucous membrane is clear-cut, and as the prism of the cystoscope is withdrawn into the urethra, its margin appears as a well-defined, dull red curtain, lifting up and closing out the bladder picture (Fig. 80). In men, the conformation of the vesical neck is determined by the size and shape of the prostate. In women, the outline of the urethrovesical junction is more sharply defined and more regular than in men; in women, however, we more frequently find normal variations in its outline, due to the formation of a delicate translucent curtain of polyp-like structures which forms a collar around the vesical neck. This fold or collar consists of a series of teats of tissue, as in Fig. 81, each teat supporting a delicate loop of blood-vessels. These are in no way pathologic.

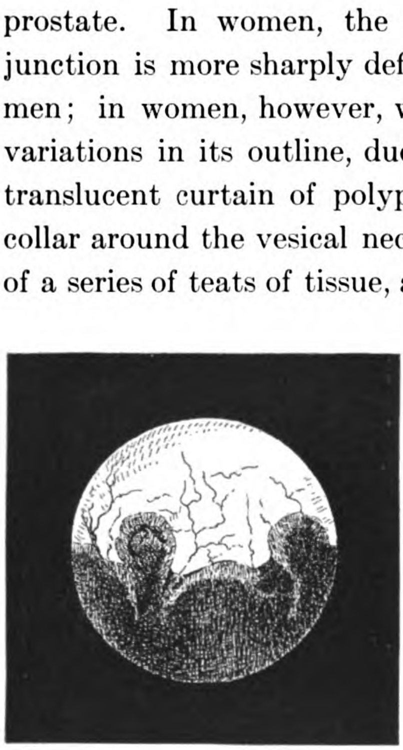


Fig. 81.—Cystoscopic picture of a normal variation of the urethral border seen in woman. These folds of tissue are commonly seen just within the urethral border and have frequently been mistaken for pathologic conditions giving rise to symptoms. They are in no way abnormal.

The Interior of the Bladder.—As the cystoscope is advanced, the interior of the bladder comes into view. Normally, the color of the *mucous membrane* may be compared with the color of the skin, varying from a yellow to a straw-color, with deepening rose tints, this color changing with the conditions of the patient, also with the intensity of the light used to illuminate the bladder. In anemic persons, the color is distinctly white. The color also appears whiter when the illuminating light is brought closer to the bladder surface, and the farther it is removed, the more rosy its color. In the normal bladder this surface has a glistening appearance, but in an inflamed bladder the epithelial surface becomes detached and the underlying tissue looks dull and swollen. The interior of the bladder may frequently appear to be unevenly streaked with red, giving it the appearance of areas of inflammation. This appearance, however, is due to a poor source of illumination.

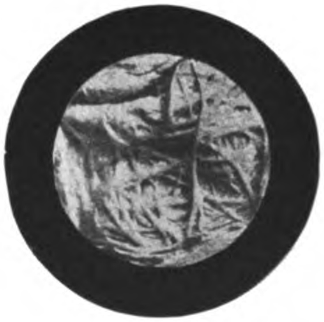


Fig. 82.—Arrangement of muscular bands on the interior of the bladder seen during spasm of the muscles of the bladder wall.

In a normal state, when containing 150 to 200 c.c. of fluid, the *bladder walls* appear almost smooth, but when a muscular spasm takes place or the bladder contracts down, the muscular strands appear delicately outlined through the mucous membrane (Fig. 82). These muscular fibers stand out distinctly on the interior of the bladder and are irregularly arranged, running in all directions, interlacing without any definite plan. If the bladder wall is thin, intestinal peristalsis may cause a slight wave motion along its surface.

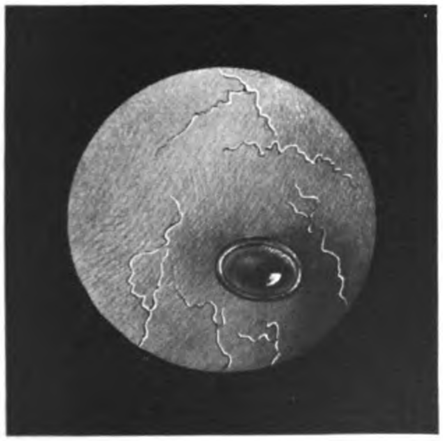


Fig. 83.—Cystoscopic picture of a normal anterior wall of the bladder showing air bubble.

The Air Bubble.—When an artificial medium is introduced into the bladder, a small quantity of air is almost always carried with it. This collects against the anterior wall of the bladder, when the patient is in the recumbent position. The bubble glistens and reflects the light from the lamp (Fig. 83). It serves as an important landmark for the observer.

The Trigone.—This is by far the most interesting portion of the interior of the bladder, for it is here that most of the pathologic processes begin, and it is also responsible for most of the distressing symptoms of bladder disease. In shape the trigone is triangular, its angles being marked by the two ureter openings and the orifice of the urethra. It is slightly elevated and its base is formed by an interureteric fold which extends between the two ureter openings (Plate VII). In form it is flat or slightly convex, but this varies considerably with the type of bladder and the condition of the internal urethral orifice. The surface of the trigone is smooth, and of a dull red color, being, as a rule, fairly distinct from the rest of the bladder. There are often distinct lines or rugæ radiating from the urethral opening, but in healthy bladders these are so slightly developed that the point of transition from the trigone to the lateral walls of the bladder cannot always be distinguished. The basal substance of the trigone contains more connective tissue than is found in other portions of the bladder, and therefore its shape is not so changeable. The interureteric fold which forms the base of the triangular trigone is composed of muscular fibers continuous with those forming the walls of the ureter; it is called the *linea interureterica;* its average length is 3 centimeters, varying from 2.15 to 3.18 centimeters. In those bladders in which the muscular bands are markedly developed, and in those in which there is a pathologic process of long standing, this interureteric band often stands out very plainly and may be developed to such an extent that a sulcus or pocket is formed behind it. Such a spot is the favorite site for the lodgment of small stones.

The Ureter Openings.—These are found at the angles of the trigone and appear as tiny slits (Fig. 84). In some cases the edges, or lips, may be thickened and present the appearance of an opening which is raised up like a cup. In a distended bladder the site of the opening is but slightly raised above the level of the surrounding tissue, but when the bladder is only partially filled or empty the openings generally occupy the summit of a low mound. This is most clearly appreciated in using an endoscopic tube. Frequently the lower lip of the ureter opening is raised up, giving it a cup-like appearance. The openings are from 2 to 5 millimeters in length. The distance of the ureter opening from the urethra averages 2.1 centimeters and varies from 1.8 to 2.5 centimeters. The point from which the ureter mouth is viewed makes considerable difference in an estimation of its shape and formation (Fig. 85).

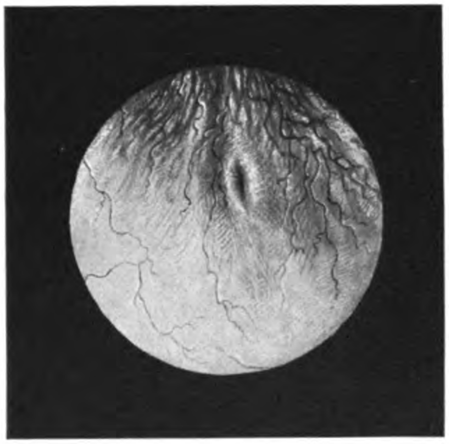


Fig. 84.—A cystoscopic picture showing a close view of a portion of the trigone and a normal ureter opening.

When an efflux of urine is about to take place, the opening puckers up and swells, and then relaxes with an outward gush of urine resembling an injection of glycerin into water (Fig. 86). The swirl may or may not be seen. The phenomenon of contraction of the opening may occur without any urine escaping. This will be commented upon later. The two ureter openings do not contract at the same time; in other words, they act independently. Each peristaltic wave of the ureter corresponds in a measure to the amount of urine secreted and the functional activity of the corresponding kidney. At times it may be impossible to find the ureter openings; sometimes, however, they may be brought into view by further distending the bladder.

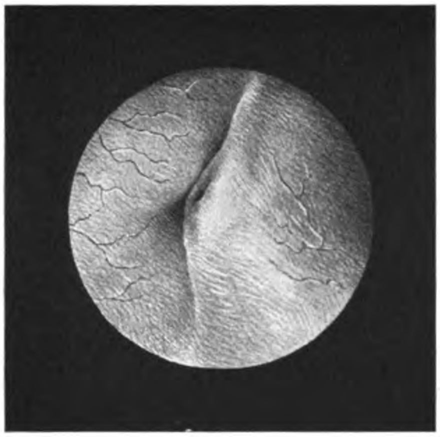


Fig. 85.—Cystoscopic picture showing a normal ureteral ridge with cystoscope close to the opening and resting on the base of the bladder.

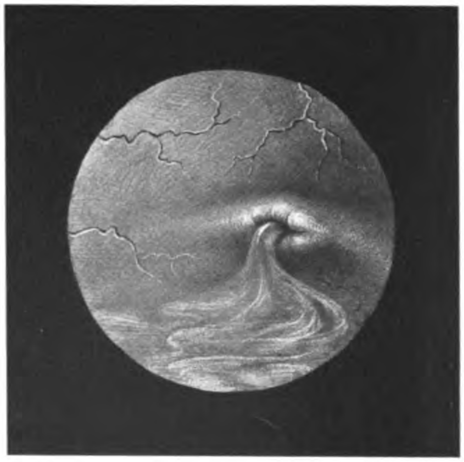


Fig. 86.—Cystoscopic picture showing efflux of urine from ureteral opening.

Normal Variations in the Shape of the Trigone.—In women, the most frequent cause of distortion of the trigone is a relaxed pelvic outlet with the formation of a cystocele. This may drag the trigone into almost any position. Its shape is also affected by the size and position of the cervix, which presses upon it and lifts it up. In the male bladder the shape of the trigone becomes distorted by the enlargement of the prostate and the distention of the seminal vesicles. Where there are scars or where cicatricial tissue forms as the result of disease, the trigone is often pulled out of shape.

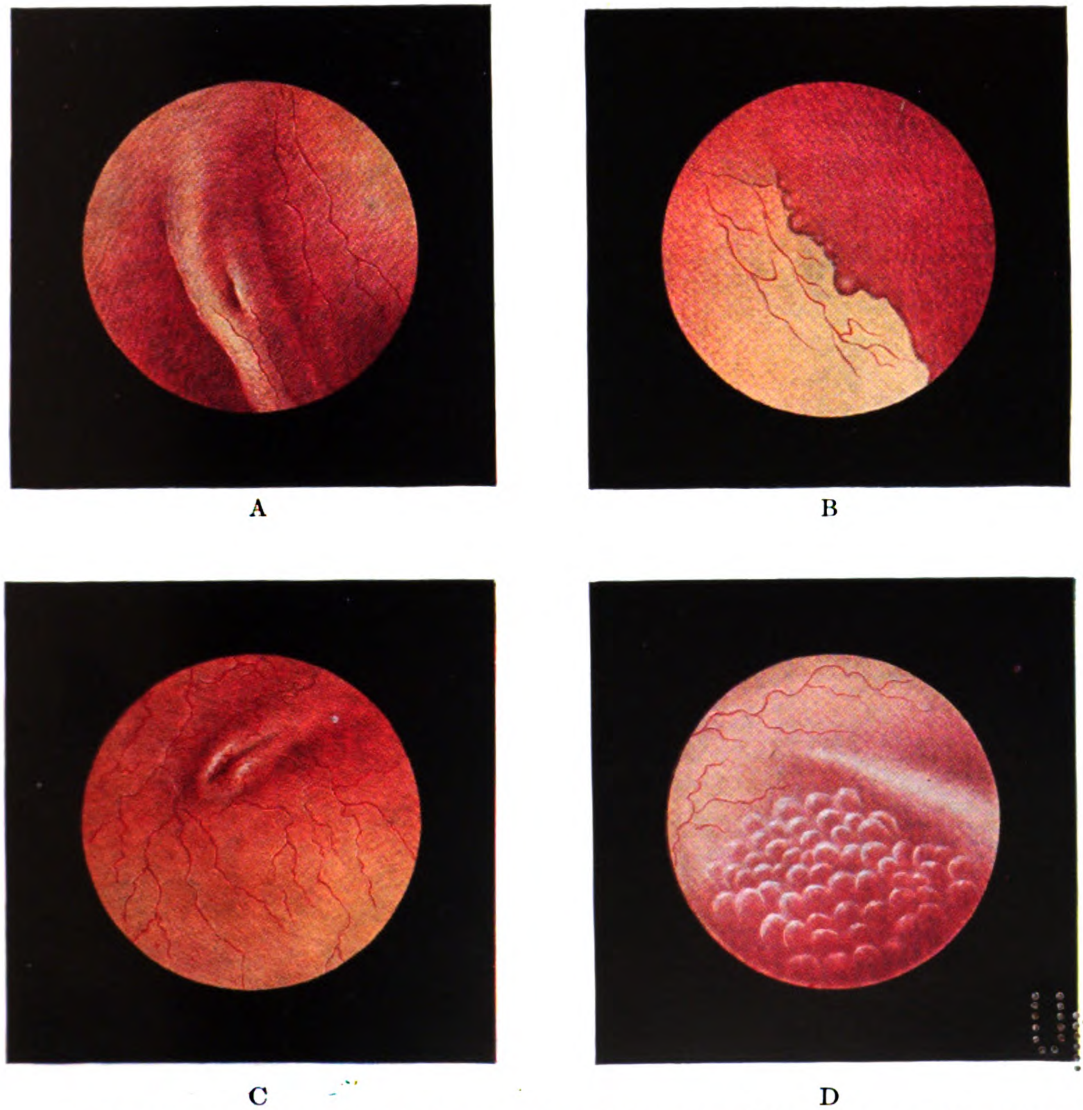
Position of the Trigone.—Normally, with the patient lying in the recumbent posture, the trigone occupies a position forty-five degrees back from the horizontal; the base of the bladder drops slightly backward from this and the course of the ureters, which run for about two centimeters through the wall of the bladder, is faintly outlined, especially during peristalsis. When the bladder is empty the trigone is more prominent and the ureter openings are raised up. In the male, by distending the bladder, the trigone becomes more elevated.

Folds of the Bladder Wall.—When the bladder is empty, or only partially distended, the walls of the viscus, when viewed from within, are seen to lie in folds. The surface of these folds appears to be congested and their irregular formation gives to the picture a streaked appearance.

The Blood-vessels.—If we view the interior of the bladder under a strong illumination we are impressed by the close resemblance between the cystoscopic picture and the appearance of the background of the eye when viewed through the ophthalmoscope. The color and general characteristics of the lining membrane are the same; the delicate network of capillaries and veins is equally contrasted against a bright yellowish-white background (Plate III). The bladder lacks any regular arrrangement of its vessels. Single parent stems are seen irregularly disposed over its surface; these stems give off numerous branches which, in turn, subdivide and form a cluster of delicate branching arterioles which scatter over the interior of the bladder. The branches are usually short and do not anastomose with other arterioles. In a normal case we expect to see in every field one or more of these clusters; in exceptional cases no blood-vessels are seen. The arrangement is different, however, in the region of the trigone and the urethral orifice. The vessels here are more numerous and their branches seem to anastomose, forming an interlacing network of delicate arterioles, and, when inflammation occurs, the swollen, congested vessels form a solid capillary wall. Hyperemia, anemia, etc., are accompanied by the same changes in the vessels as occur in other mucous membranes. Veins accompany the blood-vessels, but are more deeply placed. When seen they are of larger caliber than the arterioles and more gray in color. In older patients we occasionally see varicosed veins projecting from the bladder wall.

Normal Variations in the Interior of the Bladder.—In men few variations in the shape of the bladder are found, but in women they more frequently appear. An anteverted or anteflexed uterus, or an enlarged cervix, may press on the base of the bladder, causing a change in its interior. It makes an impression on the bladder wall

PLATE III



A, Appearance of the ureter opening and the vesical portion of the ureter when the walls of the ureter are somewhat hypertrophied. The condition is exaggerated when the cystoscope is placed on a level with and brought nearer to the object viewed. The condition is in no way pathologic. B, Irregularities of the vesical neck, showing small cyst-like bodies. C, Appearance of ureter opening in cases of renal hemorrhage. A similar condition is also seen with beginning tuberculosis of the ureter opening. D, Massive edema of the vault of the bladder and slight scar following operation of suprapubic cystotomy. This is the condition seen just after closure of the fistula.

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which can easily be appreciated by the cystoscope. Also, the symphysis pubis is more prominent in women and its impression on the bladder can be seen from within the viscus, In general, the shape of the female bladder is more variable than is the case in the male. Also, the capacity of the bladder varies. Some cases have been examined in which only 100 c.c. of fluid could be injected, while others would contain over 1000 c.c., no anatomic reason being found to account for the difference.

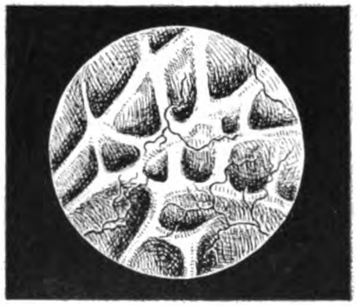
Fig. 87.—Cystoscopic picture showing moderate hypertrophy of the muscular bands of the bladder wall in a young person, without obstruction to the outflow of urine. The blood-vessels are usually visible.

Trabeculæ.—The wall of the bladder is composed chiefly of muscle-fibers gathered into bundles which run in every direction. In elderly people the intermuscular tissue disappears to a greater or less degree, causing these bands of muscular tissue to stand out more prominently. In many of the older patients, also, these bands become greatly hypertrophied and may be seen at all times on the interior of the bladder, whether the viscus be empty or full. If there be obstruction of the urethra of long standing, these muscular bundles become markedly hyper-

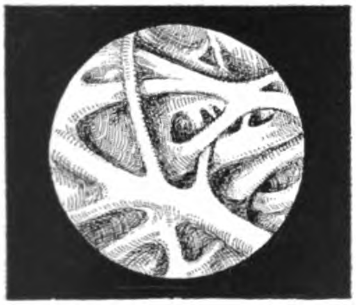
Fig. 88.—Cystoscopic picture showing marked hypertrophy of the muscular bands of the bladder wall in the aged. Note the absence of blood-vessels.

trophied and are seen in bold relief on the bladder wall (Fig. 88). As age advances, or the obstruction becomes more complete, the spaces between the trabeculæ become more deeply pitted, and we have the formation of false diverticula, due to the development of these strong muscular bands at the

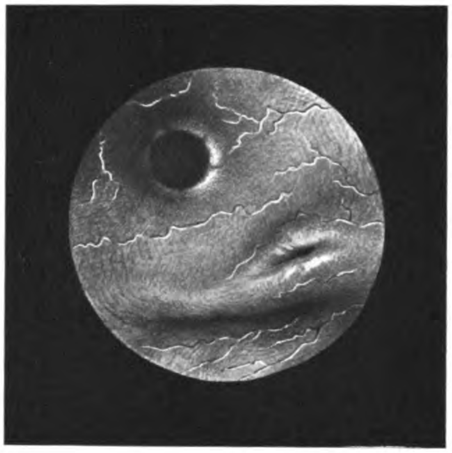

Fig. 89.—Congenital diverticulum near the ureter opening.

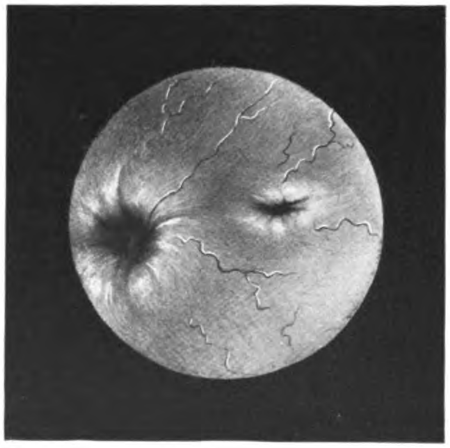

Fig. 90.—Two congenital diverticula in the vault of the bladder.

expense of the intermuscular tissue; when pressure is exerted to expel fluid from the bladder, it acts as well on the tissues between the muscular bands and forces out little pockets, thus forming the false diverticula. Occasionally, in young adults, we find trabeculation of the bladder wall of unexplained origin. In these cases, when the bladder is filled with a large amount of fluid, the trabeculation disappears; when the fluid is expelled and the bladder is partially empty, the intricate interlacing network of muscular bands again becomes evident (Fig. 87).

Congenital Diverticula.—These are occasionally found both in the healthy and diseased bladder. The openings as seen on the interior of the bladder are usually clean-cut, as shown in Fig. 89 and Fig. 90. The absence of trabeculation distinguishes them from the acquired diverticula referred to above.

SECTION III

PYELOGRAPHY

INTRODUCTION

PYELOGRAPHY is a word used to designate the process of obtaining a radiograph of the pelvis of the kidney and ureter by first injecting an opaque substance into the pelvis of the kidney and ureter and then taking an *x*-ray plate of the same. The term *uretero-pyelography* is more correct, but the word pyelography is more commonly used.

A *pyelogram* is a radiograph of the pelvis of the kidney and ureter.

Pyelography was first successfully demonstrated by Professor Voelcker, of Heidelberg, in 1906. Since then many cystoscopists, especially in this country, have developed the art, until now we have the combined experience of many observers to guide us.

It has been shown that pyelography is a branch of cystoscopy which demands the greatest amount of skill, patience, judgment, and experience. *It should never be attempted by a beginner*, and never be employed unless there is a distinct indication. The interpretation of the pyelogram is open to many possibilities of error.

Pyelography should never be attempted until all other means of diagnosis have been exhausted with the exception of exploratory operation. In the hands of a very few expert cystoscopists it is believed that the process is entirely safe. In the hands of the majority of cystoscopists whose experience is not so extensive pyelography is a dangerous experiment unless its application is limited to the simplest technic, which may result in giving as much information as the more extended examinations of the very few experts.

In the previous edition the writer set down certain mathematical limitations to guide us in this work. He agrees with Dr. Hugh Cabot, of Boston, however, that *mathematics can never be applied to the pelvis of the kidney.*

At the present time the science of pyelography is in a transitional stage, and we, therefore, are not able to set down very definite rules. The procedure is unquestionably a dangerous one, having several times resulted in the sudden death of the patient. The writer will confine himself to a more limited discussion of the subject, including the technic, accidents, and results obtained.

Equipment.—In addition to the regular paraphernalia employed in ureter catheterism, it is convenient to have a set of ureter catheters constructed so that they will cast a shadow on an *x*-ray plate. The catheters impregnated with bismuth or lead are far better than metal catheters. There are catheters for sale which are constructed so that every other centimeter of the catheter is impregnated with lead, and its shadow makes a very beautiful picture on the pyelogram.

For injecting the collargol solution *the gravity method is preferred* to the injection by means of a hand syringe. The necessary apparatus consists of a telescoping irrigating stand with arms constructed to hold two titrating burets (Fig.

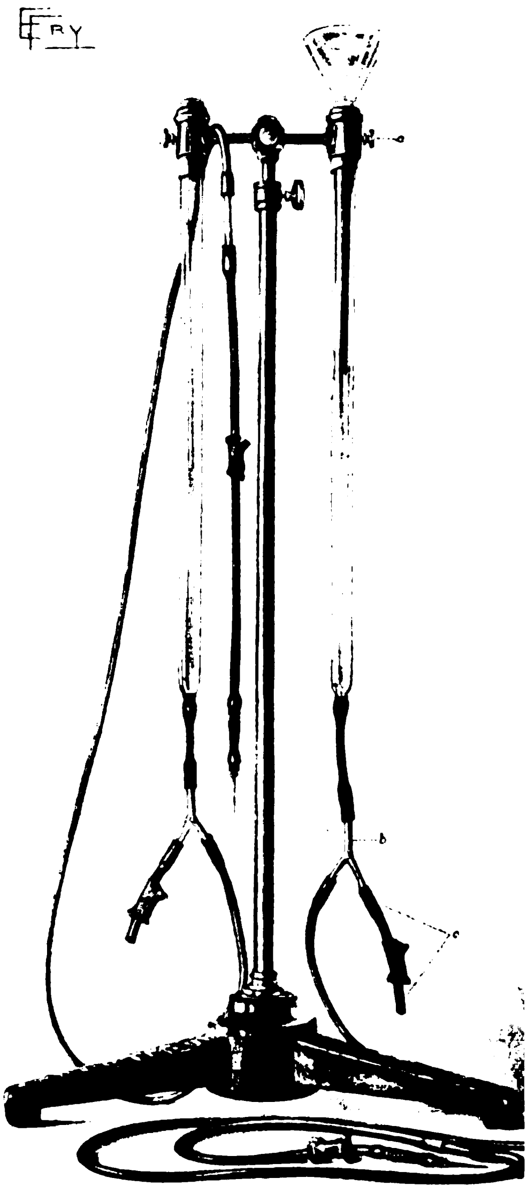

Fig. 91.—Apparatus for the injection and lavage of the pelves of the kidneys and the ureters: *a*, Control screw for raising or lowering single buret; *b*, Y-tube; *c*, tube for draining unused colloidal silver solution (Thomas).

91). The arrangement recommended by Thomas is as follows:

At the lower end of the buret is a short piece of rubber tubing of small caliber which is connected to a Y-shaped glass tube. To one arm of the Y from four to five feet of pressure tubing is attached, and to this tubing is attached the needle which is inserted into the lumen of the catheter. To the other arm of the Y is attached three or four inches of rubber tubing which has a stop-cock at its end. This is used to drain the colloidal silver from the buret before beginning to siphon. In this way the fluid which has not been used can be saved. Water may be poured into the burets to replace the colloidal silver before beginning to siphon. The control screw is used to obtain different heights of tubes.*

Solution to be Used.—A 10 per cent. solution of collargol has been found to be the best solution to use in the majority of cases. In special cases stronger solutions may be used.

Preparation of Collargol Solution.—The collargol crystals should be thoroughly pulverized in a mortar. Then the crystals are added to distilled water to make a 10 per cent. solution (this is, more correctly speaking, a suspension of very fine particles of silver). This solution is then filtered. The solution should be made fresh each day, and warmed before using.

Preparation of the Patient.—The intestinal tract should be cleared out by the use of castor oil. We prefer the patient to take two doses of castor oil—one forty-eight hours, and one twenty-four hours, before the picture is taken. During this period the diet is limited.

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* Thomas: *Jour. Amer. Med. Assoc.*, January 18, 1913.

What is the Object of Pyelography?—A. To locate the position of the pelvis of the kidney.

B. To determine the relative size and shape of the pelvis of the kidney.

C. To determine whether the kidney pelvis is encroached upon by anything, *i. e.*, tumor, etc.

D. To outline the ureter, define its position, course, and relation to the renal pelvis; to demonstrate kinks or obstructions in the ureter; to show any dilated portions of the ureter; to determine the relation of various shadows to the ureter.

Therefore, it is a valuable diagnostic aid in cases of—1. Kinks or twists of the ureter; constriction, obstruction and dilatation of the ureter.

2. Anomalies and congenital maldevelopments of the ureter, including the position of the pelvo-ureteral junction.

3. Contractions and dilatation of the renal pelvis; for the identification of renal tumors; in congenital maldevelopments of the kidney, *i. e.*, pelvic kidney, fused or horseshoe kidney, solitary kidney, etc.

4. To differentiate *x*-ray shadows in the region of the kidney or ureter.

5. It is seldom justified or necessary in cases of movable kidney or stone in the kidney.

Pyelography should be employed only when it is impossible to arrive at a diagnosis without its aid. This ruling does not, however, apply to the limited number of experts in whose hands pyelography has a much wider field.

CHAPTER I

TECHNIC

THE writer will limit himself to descriptions of the technic which he has found to be the most safe and which will give satisfactory results in the great majority of cases. He would advise those who do not obtain sufficient data by these means to seek counsel before exposing the patient to further dangers.

Anesthesia.—Any form of general anesthesia is absolutely contraindicated, either by inhalation or by injection. Local anesthesia may be applied to the urethra.

Position of the Patient.—While the injection is being made the patient should be in the usual position for cystosscopy. After a picture has been taken in this position the patient may be raised to a sitting posture, but should not be allowed to stand up or exert himself while the injected fluid is within the kidney pelvis.

Cystoscopic Technic.—An ordinary double ureter cystoscope should be used. The catheters are passed into the ureters in the usual way. Special radiographic catheters, No. 6 French, should be used, *i. e.*, those which are impregnated with lead by preference. The catheters should be advanced 10 to 15 cm. If the catheters cannot be advanced more than 2 or 3 cm., it is useless to inject the collargol. If the catheters are arrested at any point above this, a beautiful picture may result, but failure is frequent unless the catheter is advanced at least 10 cm. The beginner would better inject the fluid with the catheter advanced 10 to 12 cm. If the catheter reaches the pelvis of the kidney, trauma may be produced and accident follow. The more expert operator must choose his own method. Personally, I believe that the catheter should be slowly advanced to the pelvis of the kidney. The urine contained in the pelvis should then be collected and examined. Much can be learned from this alone (see "Hydronephrosis," p. 332, etc.). In fact, the presence of a large hydronephrosis or pyonephrosis should preferably be determined by the catheter and microscope alone, in preference to the pyelogram; *our real problem is to determine the cause of the disease in these cases.* Obstruction is the usual cause, and is most often found at the pelvo-ureteral junction or in the ureter. Therefore, after the pelvis of the kidney has been drained, the catheter should be withdrawn 8 to 10 cm. before the collargol is injected. This rule applies to nearly all conditions of the kidney and ureter with the exception of renal tumor, in which case it is probably better to inject the pelvis of the kidney directly.

In a recent study of pyelography Keene and Pancoast* point out certain precautions which should be observed, as follows:

"If the urine is blood stained, the injection is not made, a subsequent examination being advised at an interval of at least seven days. When an obstruction is encountered along the ureter, we do not attempt forcibly to overcome it, but pass a smaller catheter; if its passage is likewise impeded, the collargol is injected and, in the majority of instances, will find its way upward. The forcible passage of the ureteral catheter is to be condemned under any circumstance, but this is especially true when injection is to follow. *We are opposed to the routine practice of simultaneous injection of both kidneys;* when bilateral disease is suspected, the injections are made at two sittings. If, for any reason, the roentgenogram is unsatisfactory, we make it a rule to allow several days to elapse before attempting a second injection."

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* Keene and Pancoast: *Jour. Amer. Med. Assoc.*, August 15, 1914, p. 527.

Injecting the Collargol.—The beginner should never inject more than 5 c.c. of a 10 per cent. collargol solution into the pelvis of the kidney. It has been our experience that with this amount we can usually obtain sufficient data for diagnostic purposes. The pyelograms are not always so perfect, but the desired information can be obtained in the majority of cases, and the possibility of accident to the patient is reduced to a minimum. The more expert cystoscopists must judge for themselves.

The Gravity Method.—The warmed 10 per cent. collargol solution is filtered through cotton into the buret. After the ureter catheter has been placed in the desired position and the patient arranged on the *x*-ray table, with everything ready to make the *x*-ray exposure, the collargol solution is allowed to flow through the rubber tube to the end of the needle. The lower end of the buret should be about 18 inches above the level of the kidney. The needle is then inserted into the proximal end of the catheter and the collargol solution is allowed to run in. It may be necessary to raise the buret to overcome the resistance of the renal pelvis. We believe, however, that the lower end of the buret should not be raised more than three feet above the level of the kidney. (Buret stand, Fig. 92.)

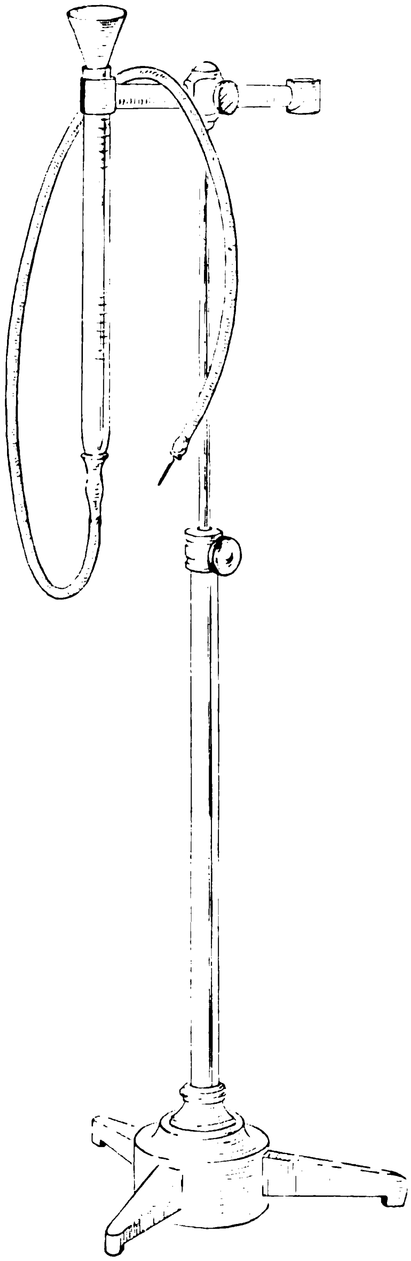

Fig. 92.—Apparatus recommended by author, consisting of simple stand and buret with rubber tube and cannula attached. The solution, when ready to inject, is filtered into the buret hot.

While the collargol solution is running in, the *x*-ray picture should be taken (Braasch). As soon as the exposure has been made, the needle is removed from the catheter, and the collargol is allowed to run out; or a syringe is used and the collargol withdrawn. Whether we allow 5 c.c. or more of the solution to run in must depend entirely on the judgment of the operator. If the kidney pelvis is dilated, it will contain a certain amount of residual urine with which the collargol will mix and the clearness of the picture will be dimmed. However, with our improved *x*-ray machines and intensifying screens the lesion can be easily demonstrated.

The injection of collargol should invariably stop the moment there is any real discomfort or pain in the region of the kidney.

The patient should be kept quiet for some time after the injection.

Radiographic Technic.—The special points to be emphasized are:

1. Stereoscopic plates should be taken if possible.
2. The picture should be taken with the patient holding the breath at the end of a deep inspiration.
3. Two radiographs should be taken: one of the entire abdomen and a second of the kidney and ureter alone.

CHAPTER II

DIAGNOSTIC VALUE OF RADIOGRAPHIC STUDIES OF THE URETER AND KIDNEY

It must be remembered that irregularities in the ureter, bends of the ureter, anomalous types of renal pelvis, and unusually large pelves are not necessarily pathologic. The pyelogram should never be accepted alone as an index of disease: it must be supported by very definite signs and symptoms of disease. A kink or bend of the ureter may be found, or an unusually high insertion of the ureter into the renal pelvis, but unless these are associated with dilatation above these points, operative interference is not indicated.

After using this aid to diagnosis in over 2000 cases Braasch* says:

"The clinician who has had considerable experience with cystoscopy and with the interpretation of shadows in radiograms of the urinary tract, and who has an opportunity to see his diagnoses checked up at the operating table, realizes that these diagnostic methods will frequently mislead the operator. Naturally, the more experienced the clinician, the less will be the percentage of errors. But even with wide experience *the two diagnostic methods, when used independently,* often fail in the diagnosis of hydronephrosis, in the identification and extent of inflammatory changes in the kidney and ureter, differentiation of extrarenal and extra-ureteral shadows, localization of renal shadows, identification of renal tumors, identification and localization of ureteral obstruction, hydro-ureter, and the diagnosis of congenital anomalies. It is in the above conditions that uretero-pyelography alone can give us accurate data as to the nature and extent of the lesion. Whether or not this will be regarded as necessary depends on the degree of accuracy desired in the diagnosis."

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* Braasch: *Jour. Mich. State Med. Soc.*, April, 1913.

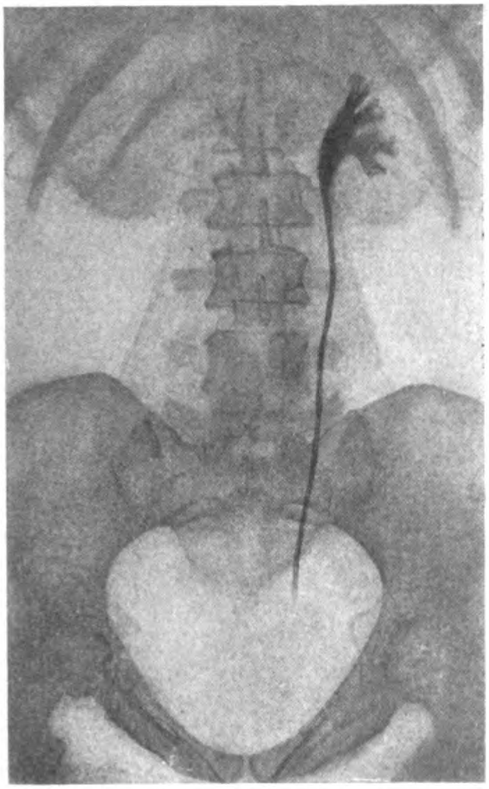


Fig. 93.—Semidiagrammatic radiogram of a normal kidney pelvis of a normally placed kidney injected with 10 per cent. collargol solution. This shows the ideal, anatomically correct, morphologically exact picture.

What may be considered as the normal shadowgraph of the ureter and kidney pelvis? It is impossible to establish any fixed standard. An added stumbling-block is the fact that *we may have anomalous forms of renal pelvis and angulations, or curves of the ureter without any evident pathology.*

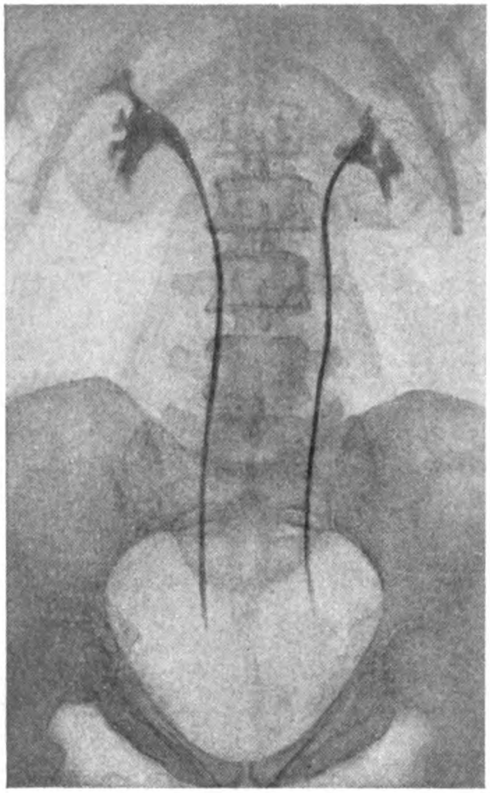


Fig. 94.—Semidiagrammatic radiogram of the renal pelves in normal cases. It shows the right renal pelvis almost ideally correct, while the right ureter is somewhat out of line. The left kidney pelvis is somewhat distorted, but still normal.

The Normal Kidney.—The content of the normal renal pelvis varies greatly. Normally, its upper margin is convex and its lower margin concave. The pelvis may be either single or double, the latter being rare. The number of calices shown on the plate varies, but it is the form of these calices, and not the number, which is of importance.

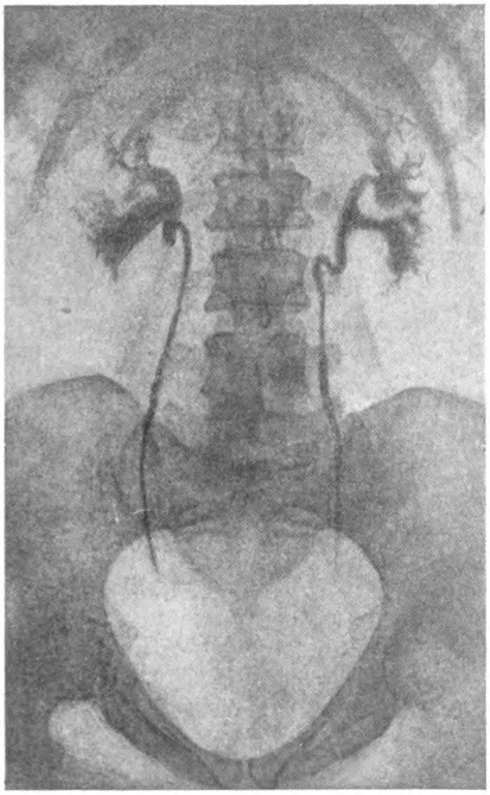


Fig. 95.—Semidiagrammatic radiogram showing marked variations found in a series of radiograms taken of a normal kidney. The right ureter shows a double twist and anatomic bend. The pelvis is almost bifid, and the collargol is seen in the collecting tubules. The left kidney shows a double bend, so-called safety drip deformity, with bifid pelvis, in a kidney whose function is perfectly normal (after Childs and Spitzgar).

Congenital Malformation of the Kidney and Ureter.—Disease developing in congenitally malformed kidneys and ureters is extremely interesting. The horseshoe kidney is commonly affected by hydronephrosis, which may later develop into pyonephrosis (Mayo). Congenital cystic kidney usually shows deformity of the calices, and congenital single kidney presents unusual variations in the size and shape of the pelvis.

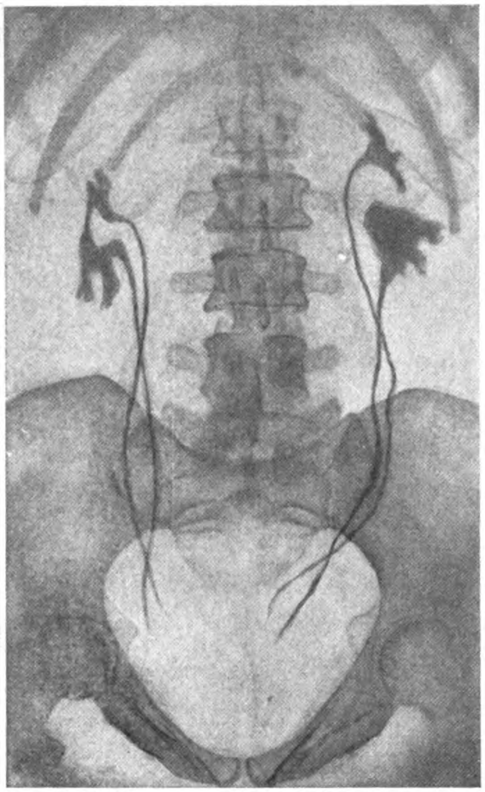


Fig. 96.—Semidiagrammatic radiogram showing bilateral duplication of ureters and pelves. Duplication of left kidney pelvis complete, with small hydronephrosis and stone in the lower pelvis. The two pelves of the right kidney united by a common calix (after Mayo).

Tumors of the Kidney.—The most extensive observations of these cases have been made by Braasch. He finds that the renal pelvis is involved in 75 per cent. of the cases. The changes noted in his series were:

Retraction of one or more calices; partial obliteration of the pelvis; irregular pelvic dilatation following tumor necrosis or infection; displaced pelvis or ureter due to growth of tumor.

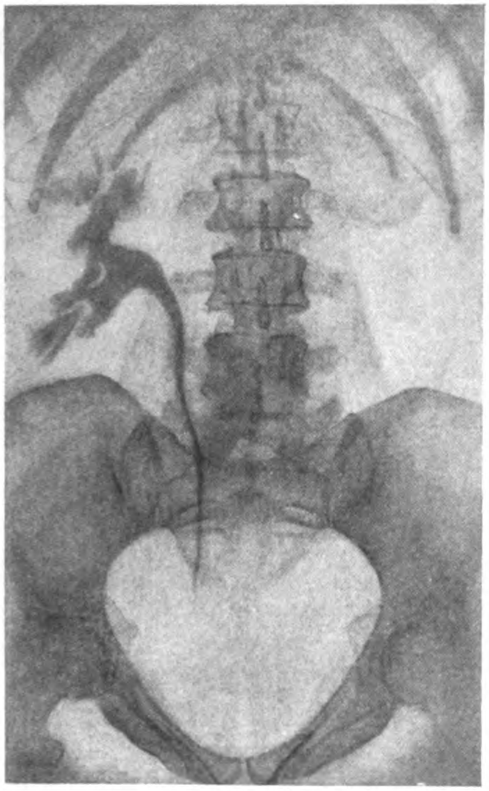


Fig. 97.—Semidiagrammatic radiogram showing a normal pelvis in a large whitened kidney. The cortex shows collargol.

A study of the plates taken in these cases shows that the pelvis is encroached upon in various ways, so that the resulting shadows at times make grotesque figures, streaks, and irregularities.

Displacement of the renal pelvis due to ptosis of the kidney (ren mobilis), abnormal fixation of the kidney, rotation of the kidney, or displacement due to extrarenal tumor, etc., can be demonstrated by the pyelogram.

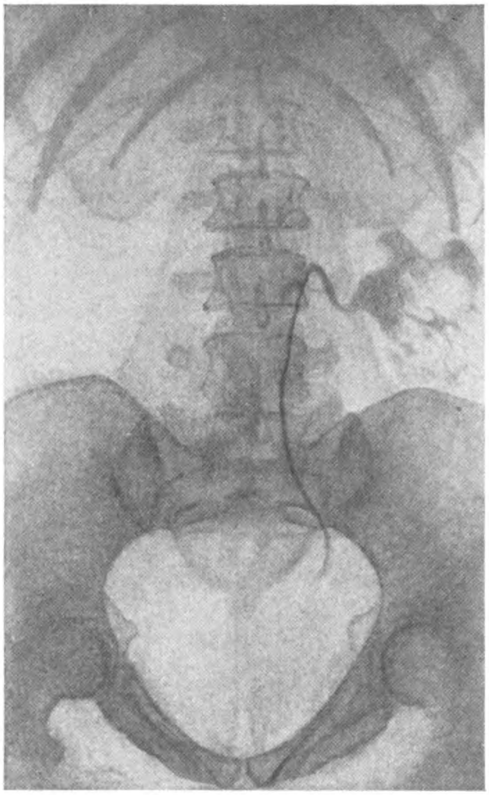


Fig. 98.—Semidiagrammatic radiogram showing a pathologic kink in the ureter, with the left kidney enlarged, the pelvis hydronephrotic, and collargol infiltrating the parenchyma.

Hydronephrosis and Pyonephrosis.—This phase of the subject is discussed at length under the general subject of these diseases. (See p. 332.) It may be well to repeat here, however, that a large hydronephrosis or extensive pyonephrosis can usually be diagnosed without the aid of pyelography.

Tuberculosis of the Kidney.—The writer does not feel that pyelography is indicated or of special value in these cases. Pyelograms taken of tubercular kidneys will show various deformities in proportion to the amount of tissue destruction, inflammatory infiltration, and dilatation due to obstruction.

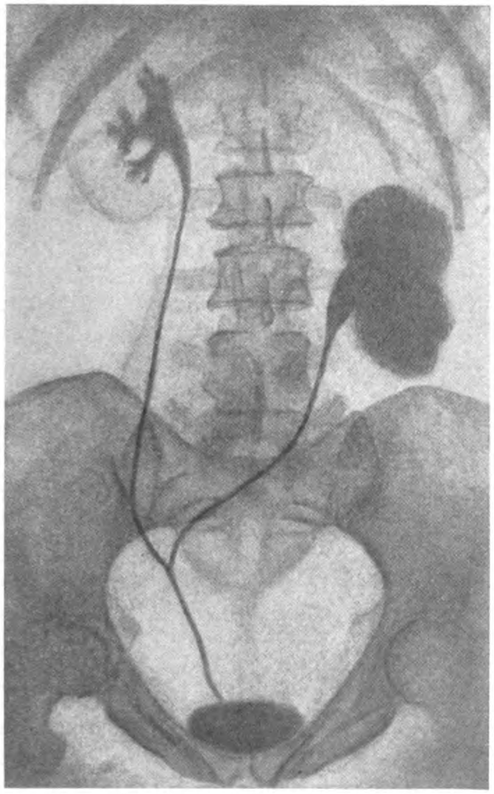


Fig. 99.—Semidiagrammatic radiogram, showing congenital abnormality (after Braasch), with single terminal ureter divided at its lower third. Left branch crosses the spine and leads to a large hydronephrosis of the left kidney. Right kidney normal.

Renal Calculus.—The collargol solution will sometimes stain a calculus so that it will show on an x-ray plate when previously it did not. Renal calculus contained in, but not blocking, the pelvis of the kidney causes, as a rule, contraction of the renal pelvis. A calculus blocking the outlet produces hydronephrosis and destruction of the kidney parenchyma. It is rarely justifiable to employ pyelography in the diagnosis of renal calculus.

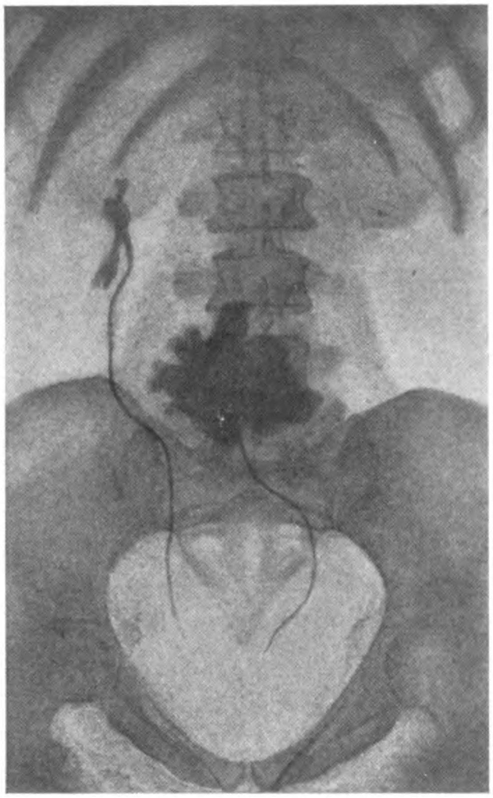


Fig. 100.—Semidiagrammatic radiogram (after Braasch), showing congenital abnormality. Picture obtained in the case of a fused kidney, showing hydronephrosis of one pelvis with a normal pelvis in the upper portion of the kidney.

Inflammatory Disease of the Renal Pelvis.—It is often essential to know whether a pyelitis is due to disease within the pelvis itself, or exists as a result of obstruction of the ureter. The pyelogram will help to differentiate these.

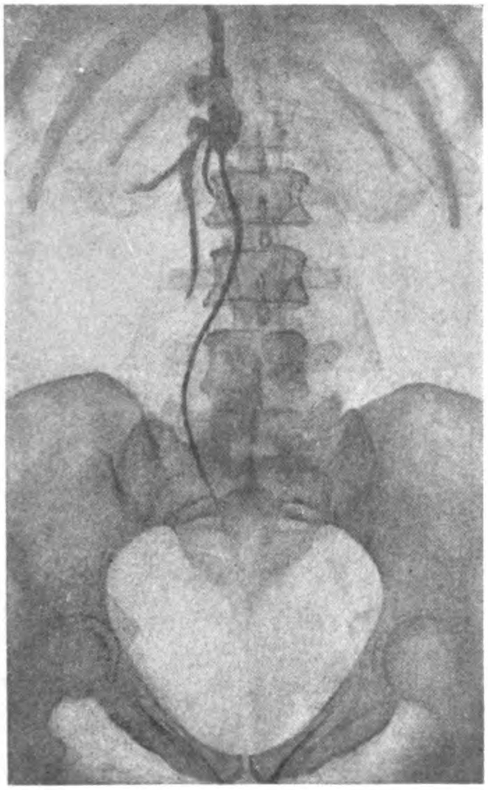


Fig. 101.—Semidiagrammatic radiogram showing so-called spider-like shadows obtained in a case of tumor of the kidney (after Braasch).

Post-operative Deformities of the Kidney and Ureter.—An accurate knowledge of the post-operative conditions of the remaining kidney tissue and pelvis is often of the greatest importance. This can frequently be determined by pyelography. For example:

CASE.—A woman, fifty-five years of age, was operated on in Chicago for calculi in both kidneys. The operation on the left kidney resulted in a permanent suppurating sinus in the left lumbar region. This occasionally became occluded, with the formation of an abscess which required incision, no urine coming from the left ureter. The operation on the right kidney resulted in a persistent urinary sinus in the right lumbar region, some urine passing through the right ureter into the bladder. The urine contained

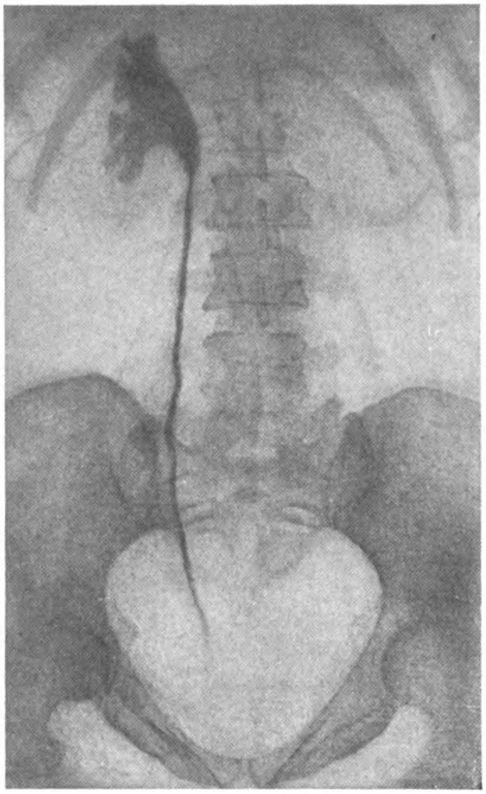


Fig. 102.—Semidiagrammatic radiogram showing a dilated pelvis, irregular ureter, and absence of the pyramids in a case of tuberculosis of the kidney. The usual markings of a kidney pelvis have been distorted by inflammation (after Cunningham).

much pus. Then the right ureter became blocked, and no urine passed through the bladder, an insufficient amount draining through the lumbar sinus. Toxic and uremic symptoms appeared, and the patient applied for relief.

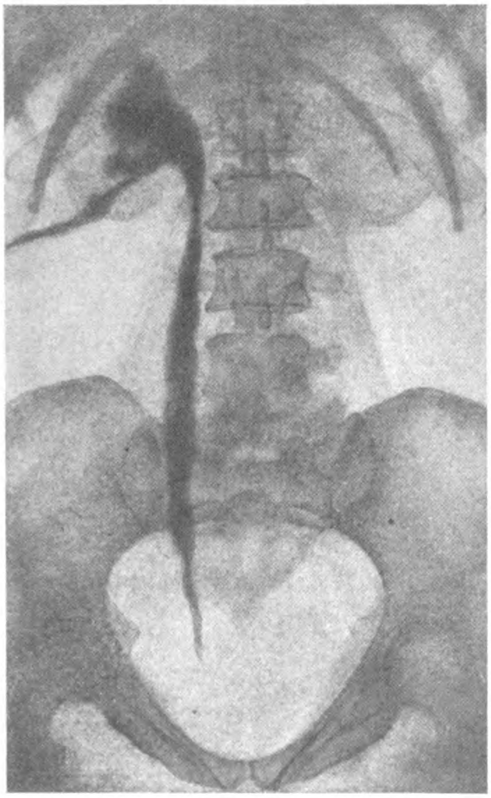


Fig. 103.—Semidiagrammatic radiogram showing conditions existing in a single remaining kidney after extensive operation for calculus and obstruction at the lower portion of the ureter, the fistulous tract leading to an opening in the lumbar region and hydronephrosis of the kidney. This case was relieved by dilating the ureter and the sinus healed spontaneously.

Cystoscopy and pyelography were done by the writer, and the resulting picture (Fig. 103) showed plainly the entire pathology in the case, *i. e.*, pyonephrosis, reno-abdominal fistula, hydro-ureter with obstruction near the bladder, inflammatory obstruction of ureter. The condition of the patient did not justify further examination of the left ureter at that time. The treatment based on this picture, *i. e.*, gradual dilatation of the ureteral constriction with lavage of the renal pelvis, resulted in the rapid recovery of the patient, closure of the lumbar sinus, and disappearance of all symptoms referable to the right kidney. The sinus in the left lumbar region was healed by injection of bismuth paste. To-day, two years since the dilatation of the strictured ureter, the patient appears perfectly well, without any symptoms of obstructive renal disease.

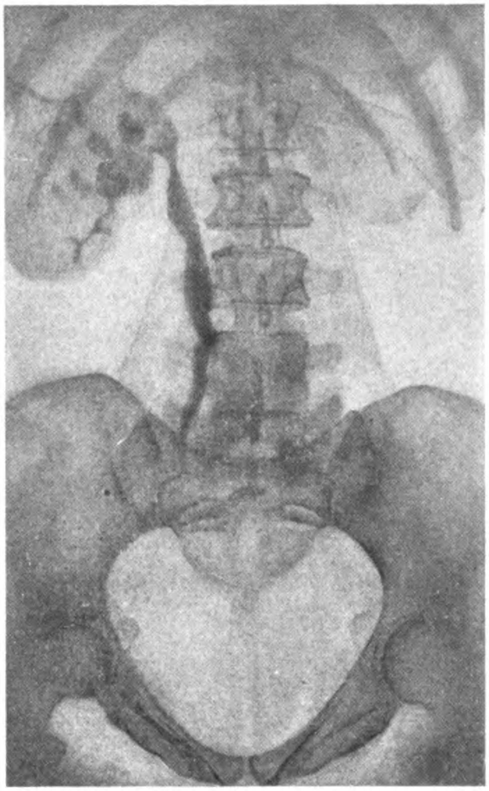


Fig. 104.—Disorganized condition of single remaining kidney and ureter, with good function.

Anomalies of the Ureters.—Dilatation of the renal pelvis may result from a high implantation of the ureter into the renal pelvis. This and many other anomalies can be safely demonstrated by pyelography. It may be said in general that in all cases where only a single ureter opening is found in the bladder that the ureter should be injected with collargol and radiographed before any correct conclusion can be arrived at. The single ureter may divide and drain two kidneys, one diseased and the other normal; or may

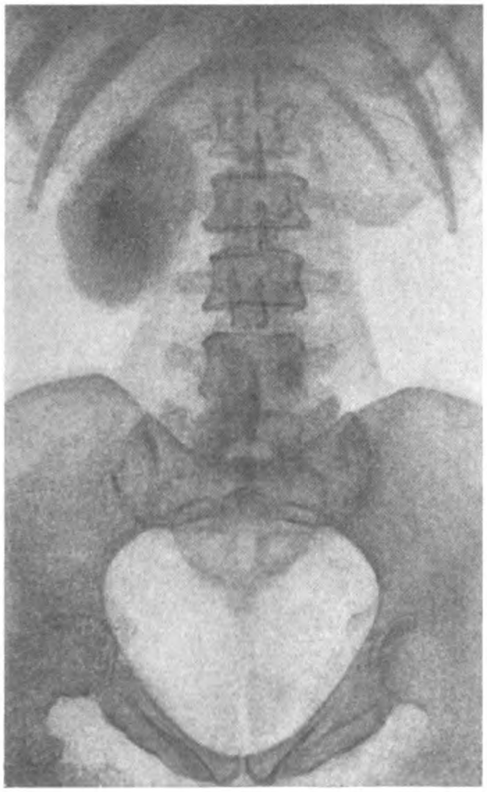


Fig. 105.—The goose-egg shadow. Typical pyelogram of intermittent hydronephrosis due to constriction of ureter by aberrant blood-vessel.

drain a solitary kidney with a double pelvis, one of which is diseased. One can never tell beforehand what the pyelogram will show.

Extra-ureteral Conditions Causing Obstruction of the Ureter.—Aberrant blood-vessels going to the lower pole of the kidney cause obstruction of the highest segment of the ureter, with the production of an intermittent hydronephrosis. (See p. 325.) Pregnancy, abdominal tumors, etc., may cause hydro-ureter. The uretero-pyelogram will show us the location of the obstruction.

Ureteral Calculus.—The same applies here as in the case of renal calculus. In order to determine the amount of harm that is resulting from the presence of a stone in the ureter, *i. e.*, the amount of dilatation of the ureter due to the obstruction by the stone, a uretero-pyelograph is often quite essential. *Kinks, bends, twists,* or other deviation in the course of the ureter can be demonstrated. No such deviation, however, should be considered pathologic unless it is associated with dilatation of the ureter above the point of deviation.

Wounds or fistulæ along the urogenital tract can be easily demonstrated.

CHAPTER III

THE ACCIDENTS AND DANGERS OF PYELOGRAPHY

RATHER extensive experiments have been made by various observers to establish just what harmful effect followed the use of collargol in pyelography. These studies take into account the amount of fluid injected and the pressure with which the injection was made; also the employment of various substances, including collargol, cargentos, and methylene-blue. The most recent and convincing of these experiments have been made by Dr. Daniel N. Eisendrath, and his associates, in Chicago. It was found that, in those cases where the amount of collargol injected did not exceed the capacity of the renal pelvis, where only sufficient pressure was used to distend the pelvis lightly, no damage to the kidney or the epithelium took place. Where the pressure and quantity were increased, the tension of the renal pelvis was raised and the solution was forced into the interstitial tissue and tubules; increased pressure forces the solution into the blood-vessels and it is carried by the veins to the lungs, producing embolism with sudden death, or acute pulmonary edema, hemorrhagic infarct, or pneumonia.

In other words, the conclusion arrived at from these experiments shows that unless the capacity of the kidney pelvis is exceeded, harm does not usually result.

There is a point, however, which has not been clearly brought out, which is this—that we have no way of determining the real capacity of the kidney pelvis under varying conditions. For example, a hydronephrotic kidney may have a pelvis containing 60 c.c. of purulent urine. When, however, this urine is removed by catheter from the kidney pelvis, and a foreign substance, such as collargol solution, is injected into the kidney pelvis, its capacity changes, the pelvis contracts, and, where previously the capacity may have been 60 c.c., the capacity for collargol may be 30 or only 20 c.c.

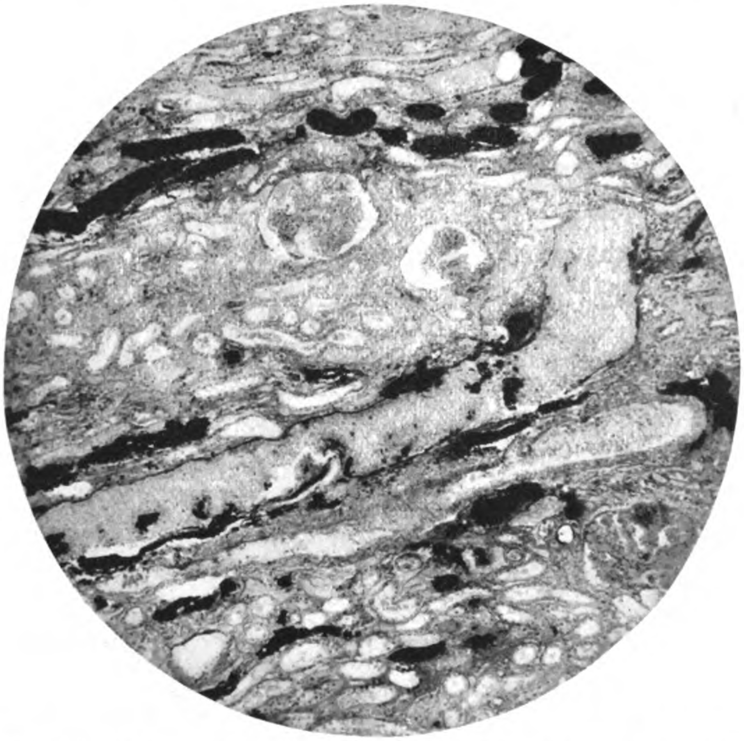


Fig. 106.—Microphotograph of a section of kidney whose pelvis has been injected with collargol under too great pressure. The dark deposits represent collargol pigment, in some places occupying the tubules, but in the center of the photograph the pigment is shown breaking through into a blood-vessel (Eisendrath).

Aside from the accidents already referred to, many other untoward results have followed the injection of collargol into the renal pelvis. These include fatal collargol poisoning (Roesole); destruction of the entire mucous membrane of the renal pelvis; rupture, by overdistention, of a large hydronephrotic kidney pelvis; collargol infiltration of the kidney parenchyma; systemic collargol infarction.

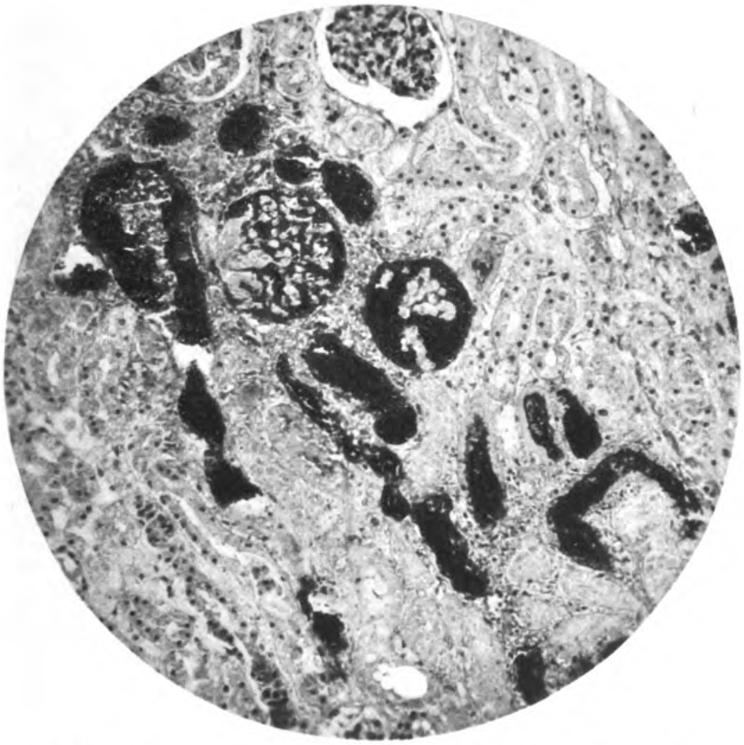


Fig. 107.—Microphotograph showing section of kidney tissue whose pelvis has been injected with collargol solution under too great pressure, resulting in a deposit of collargol pigment in the tubules and glomeruli. Twenty per cent. collargol solution was used (Eisendrath).

Keyes has recently shown that there is still another factor of greatest importance which must be considered in these cases, and that is what we may term *a secondary phase*, coming on some hours after the injection, even in those cases where there has been no pain or discomfort resulting primarily from the injection, and without over-distention of the pelvis. In his experiments it has been shown that a solution of collargol might be injected into the ureter alone and the kidney pelvis not distended by the solution, the ureter being tied near the bladder so that none

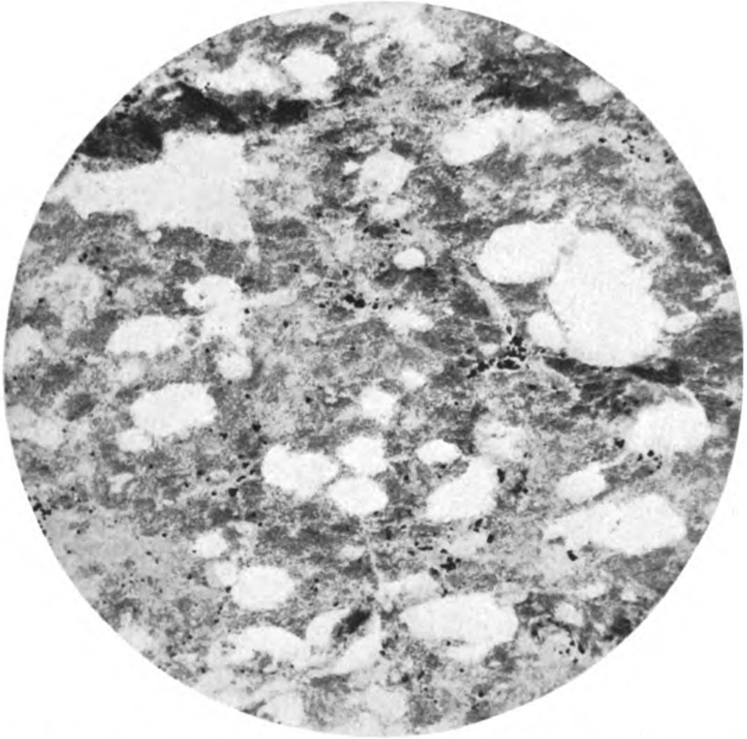


Fig. 108.—Microphotograph of lung tissue from a dog, the pelvis of whose kidney had been injected with collargol under too great pressure, showing hemorrhagic infarct around collargol pigment which had found its way into the lung, causing death. Twenty cubic centimeters of 10 per cent. collargol was injected under a pressure of 196 mm. into the pelvis of a hydronephrotic kidney (Eisendrath).

of the injected collargol will escape, an absolute retention being present in the pelvis. After this solution has remained for a definite time, the animals killed and autopsy done, it was shown that particles of collargol not only infiltrated the cortex of the kidney of the injected side, but collargol was also found in the cortex of the companion kidney. This would indicate that the collargol was forced into the general circulation through natural agencies, *i. e.*, overdistention of the renal pelvis, due to continued urinary excretion in the presence of an ureteral obstruction, a condition which so frequently is present in these cases in which pyelography is done. It points out also that it is *dangerous to leave any solution of collargol in the kidney pelvis after the radiographs have been taken.*

In concluding this chapter the writer wishes to emphasize the facts that he considers the method a very dangerous one in the hands of any one excepting the most expert. That the method should be used only in those cases where a definite diagnosis cannot be made by any other means. That if the method is used, the amount of collargol injected in any case should not exceed 5 c.c. That, if any symptoms of discomfort or pain should occur before this amount is reached, the injection should be stopped and the pelvis of the kidney immediately emptied. And lastly, that in every case in which collargol is injected into the pelvis of the kidney the solution should be withdrawn from the pelvis of the kidney by the use of a hand syringe and the pelvis then washed out with sterile water.

ATLAS OF PYELOGRAPHY

In order to present to the readers examples showing various types of renal disease in radiograms taken under the most ideal conditions, the author has asked Dr. William Braasch, of the Mayo Clinic, to send him examples of his work, which we present in the following pages. Supplementary to these pictures the author appends two of his own, which show examples of conditions not included in the radiograms of Dr. Braasch.

RADIOGRAMS SHOWING WIDE VARIATIONS IN THE NORMAL PELVIS, AS JUDGED FROM THE SHADOWS ON THE *X*-RAY PLATE

THE NORMAL PELVIS

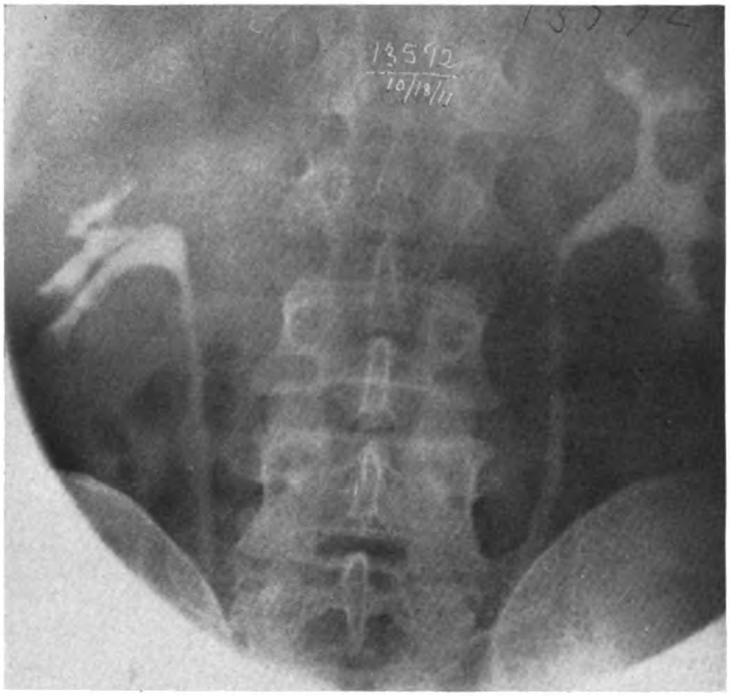


Fig. 109.—The pelves of both kidneys are normal. The right kidney is rather irregular because of excessive distention.

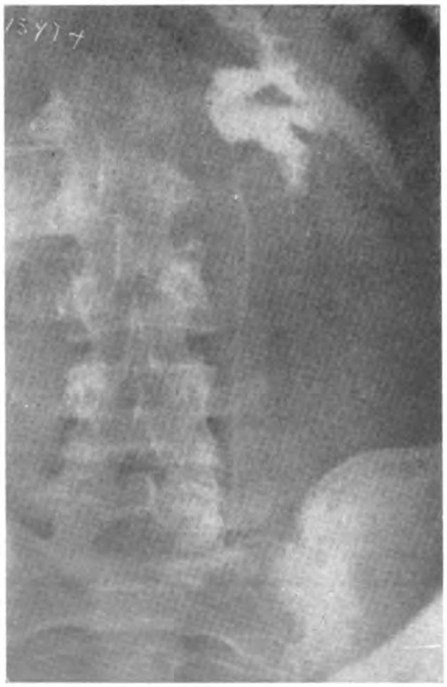


Fig. 110.—The outline of the normal pelvis is visible; both major and minor calices are well defined. The true pelvis is rather small, but normal in outline. The course of the ureter is shown by the catheter.

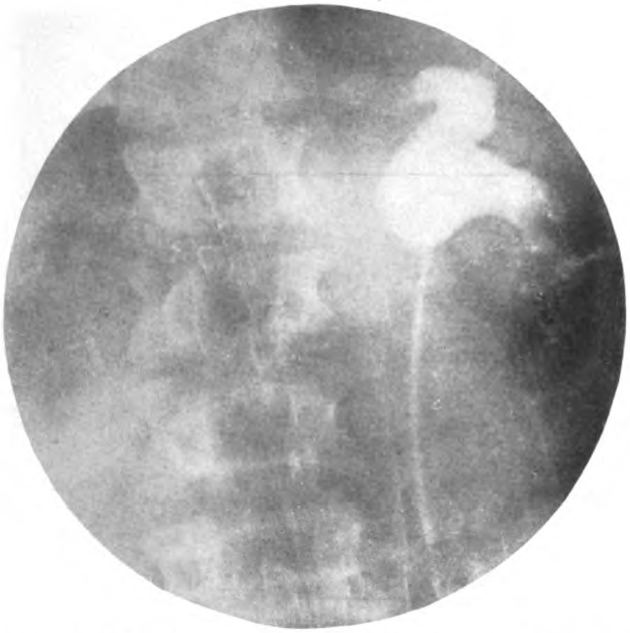


Fig. 111.—Early hydronephrosis is here illustrated. The calices are seen moderately distended, as well as flattened and broadened. The true pelvis is moderately enlarged.

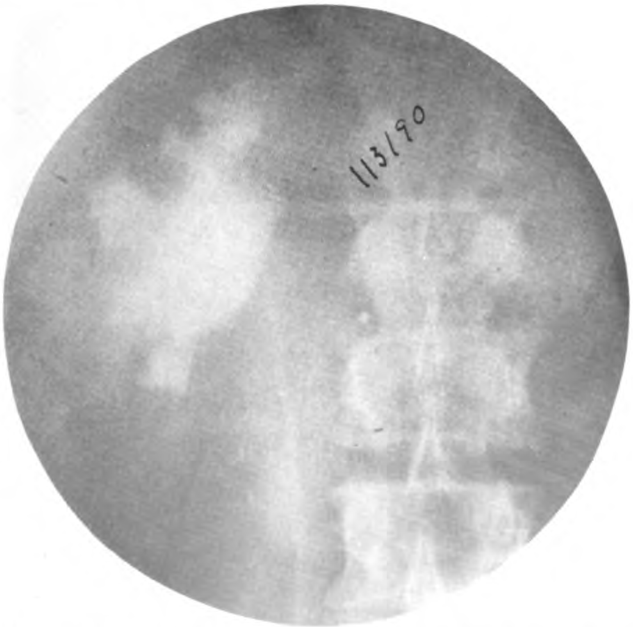


Fig. 112.—A considerable degree of hydronephrosis is apparent. The true pelvis is markedly dilated. The calices, while dilated, are not completely filled, otherwise would appear larger.

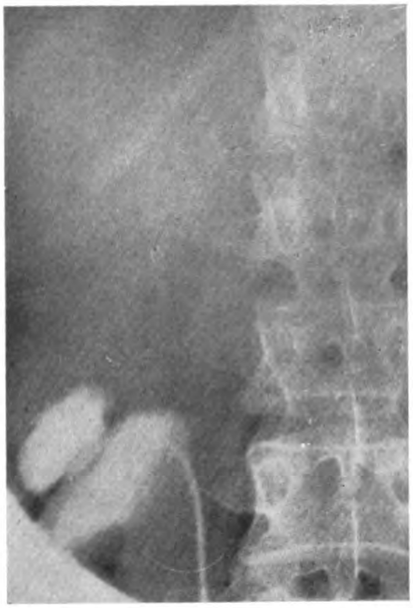


Fig. 113.—The pelvis is markedly dilated and is situated low. The calices are greatly distended, but an irregular sac remains.

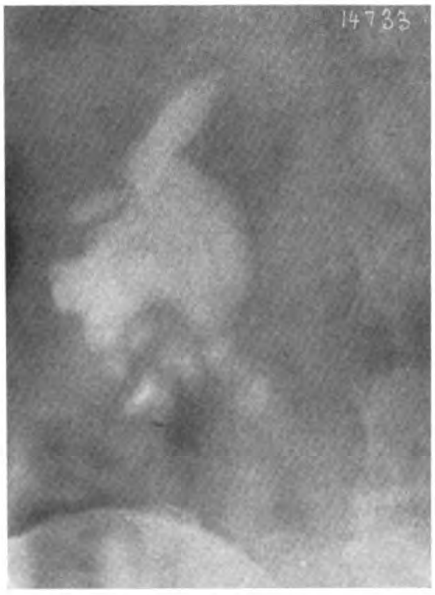


Fig. 114.—Large hydronephrosis slightly infected as result of multiple stones visible around the distended pelvis.

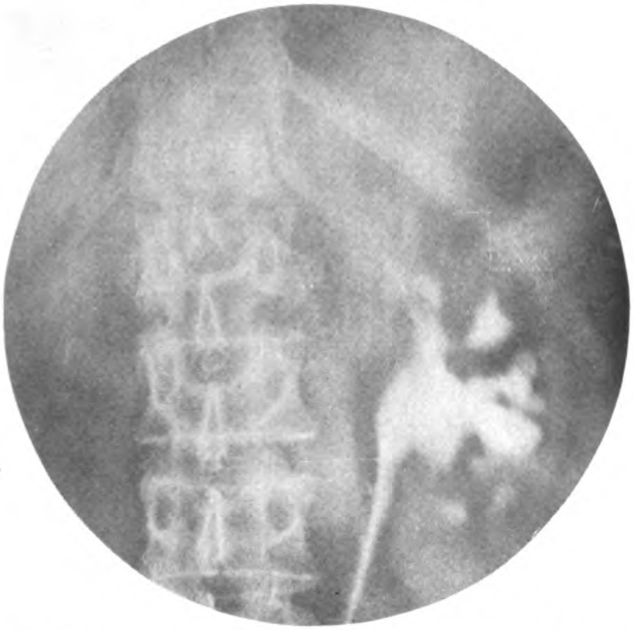


Fig. 115.—The effect of moderate inflammation is here illustrated. The calices are irregular and clubbed, typical of inflammatory dilatation.

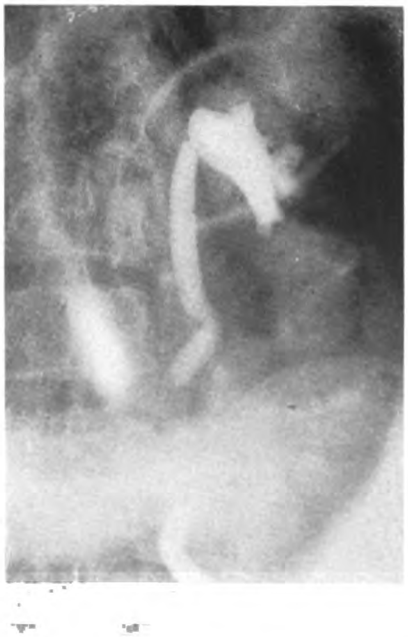


Fig. 116.—Pyelonephritis. Ureteritis. The pelvis shows moderate inflammatory changes. Of greater interest is the marked dilatation as well as the tortuous course of the ureter, the result of inflammatory process.

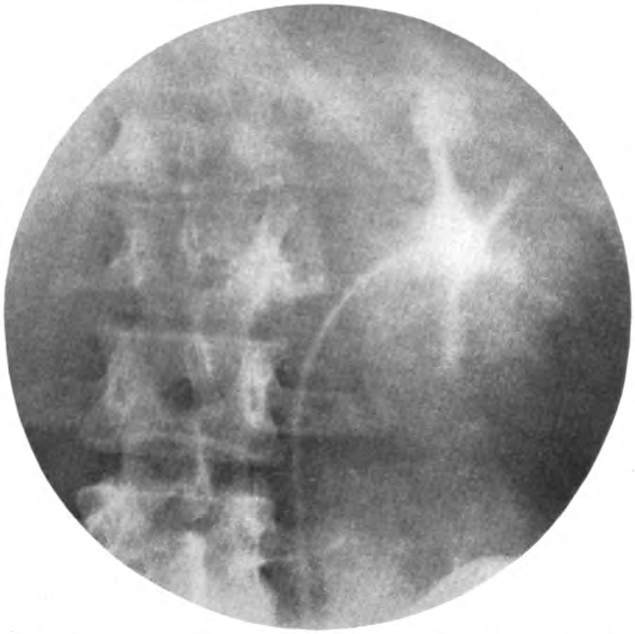


Fig. 117.—Renal tumor. Lower calices retracted and narrowed as result of surrounding tumor tissue.

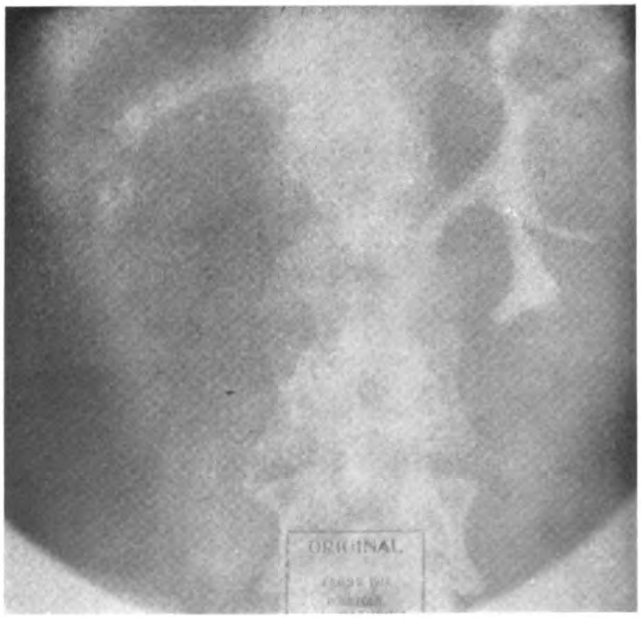


Fig. 118.—Renal tumor. Calices retracted and narrowed as result of surrounding tumor tissue.

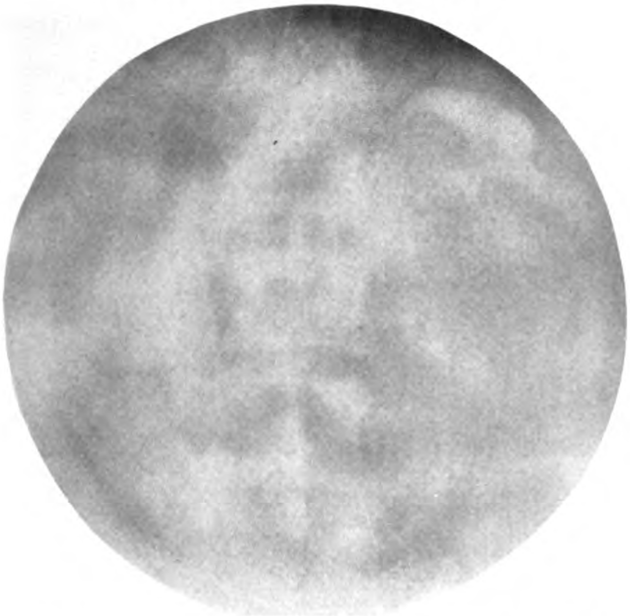


Fig. 119.—Cystic kidney. Shows the change in axis of the pelvis as well as partial effacement of the calices.

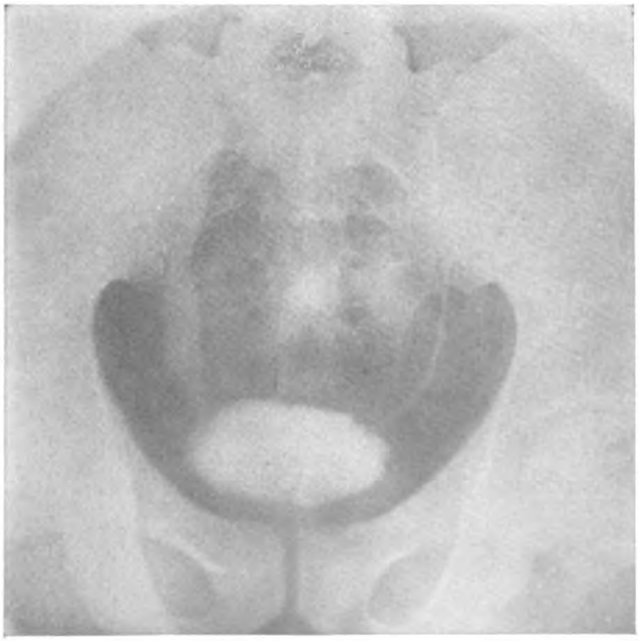


Fig. 120.—Hydro-ureter. The right ureter is markedly dilated. The obstruction is either in the bladder-wall or at the mouth of the ureter.

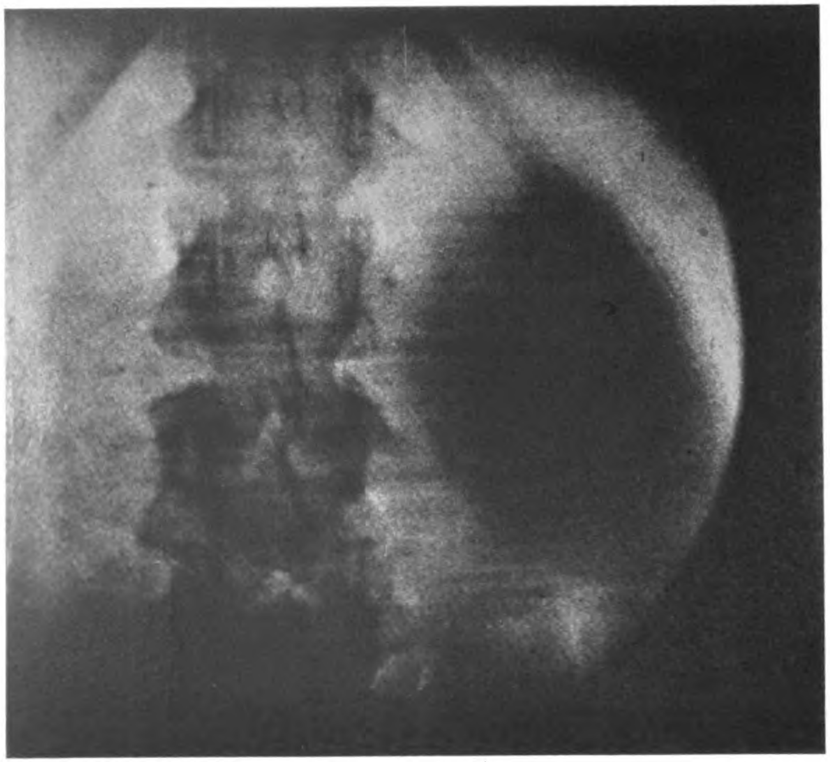


Fig. 121.—Typical conformation of renal pelvis in case of hydronephrosis from aberrant renal vessel constricting ureter.

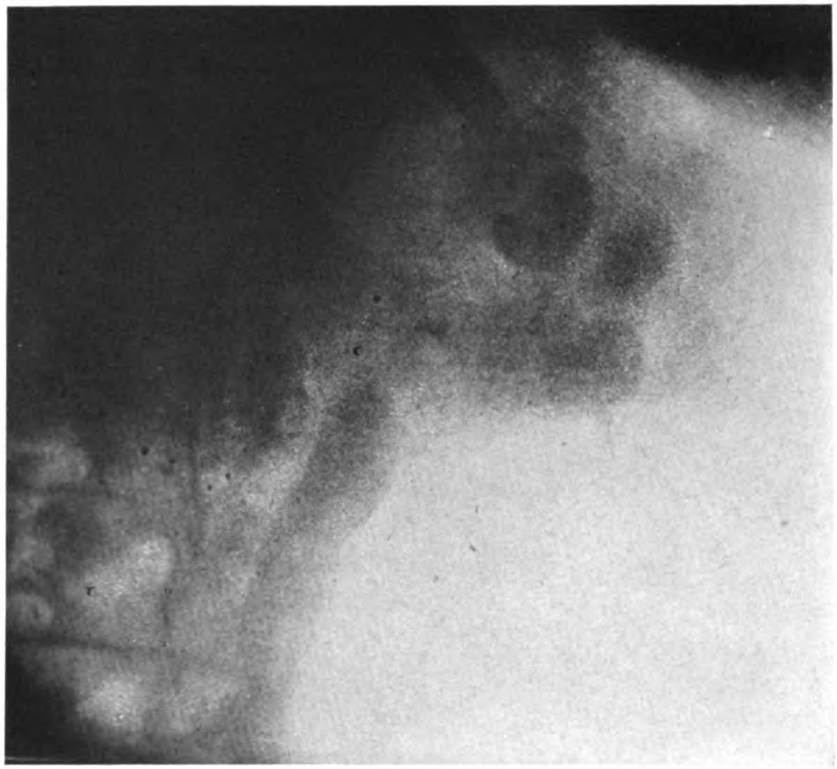


Fig. 122.—Hydro-ureter. Pyonephrosis. Renal fistula in case following removal of stones from kidney.

SECTION IV

THE TECHNIC OF URETER CATHETERISM

CHAPTER I

TECHNIC WITH THE DIRECT CATHETERIZING CYSTOSCOPE

THE student must have a thorough working knowledge of the anatomy of the bladder, ureters, and kidneys, as well as an appreciation of the dangers of infection or injury to any of these organs. He should understand the construction of the instruments he is using and should avoid complex combination instruments.

Catheters.—For the ordinary cystoscope, a No. 5 or No. 6 French or American silk ureter catheter is the correct size to use. Some of the newer catheters which have been perfected by the French are very beautifully made of silk webbing (Fig. 60), the distal end being so constructed that the urine is more easily collected from the ureters. They are marked in different colors, indicating the number of centimeters, so that looking through the cystoscope, with the catheter in the bladder, the operator is able to tell exactly how far the catheter has been advanced. These catheters may be boiled. No catheter has yet been constructed which is guaranteed to collect all the urine from a ureter or kidney, as considerable may escape alongside of the catheter into the bladder.

The Flexible Wire Stilet.—This may be useful to give additional stability to a soft catheter. It may be introduced into the ureter through the ureter catheter and will produce a very dense shadow on an x-ray plate; it is an important aid in localizing ureter stones. It casts a more distinct shadow than the catheter which is impregnated with bismuth or any of the silver salts. A stilet of finely wound piano wire, which is made for the writer by Wappler, is so flexible that if passed into a dilated renal pelvis it will curl up and not injure the lining membrane. It does not kink, as a straight or a flat wire would, and is extremely pliable. The flexibility of this stilet makes it easier to introduce in small caliber catheters.

Introducing the Instrument.—The instrument perfected by Brown, and the modifications of Cabot, Lewis, and Ayers, all consist of a sheath, obturator, and catheterizing telescope.

The instrument is introduced into the bladder with the obturator in place, using the same technic as in introducing the simple examining cystoscope. The cystoscope is steadied with the left hand, holding it near the ocular end. The obturator is withdrawn and the thumb of the left hand is placed over the opening in the end of the instrument in order to prevent the escape of fluid from the bladder The catheterizing telescope, which has been previously prepared, with the catheters in position, the outer ends plugged or capped, washers adjusted, and everything in perfect working order, is taken in the right hand. Removing the thumb, the end of the telescope is quickly entered into the sheath and locked in position. The operator then assumes as comfortable a position as possible, attaches the cord from the battery, turns on the current, and looks through the telescope. He may then make a systematic examination of the bladder and locate the ureter openings. This at first may be a difficult task, for the ureter openings do not stand out as prominently as might be expected. The beginner must be instructed by some one who has had experience in this work, before he can accomplish it without causing unnecessary discomfort to his patient. After advancing the instrument well into the bladder it is best to gradually withdraw it until the trigone comes into view. This will appear considerably magnified on account of the nearness of the lens to the object viewed. The trigone looks lumpy, and numerous spots may be seen which at first look like probable hiding-places for the ureter opening. If the interureteric band can be recognized,

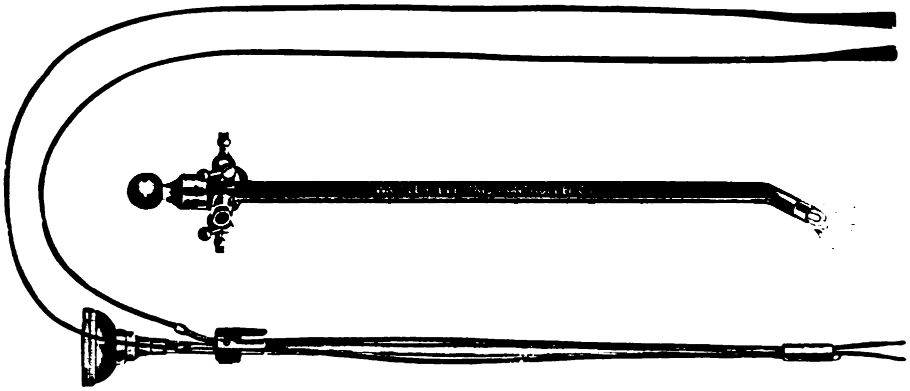


Fig. 123.—The Brown direct catheterizing cystoscope with catheter in canal ready for use.

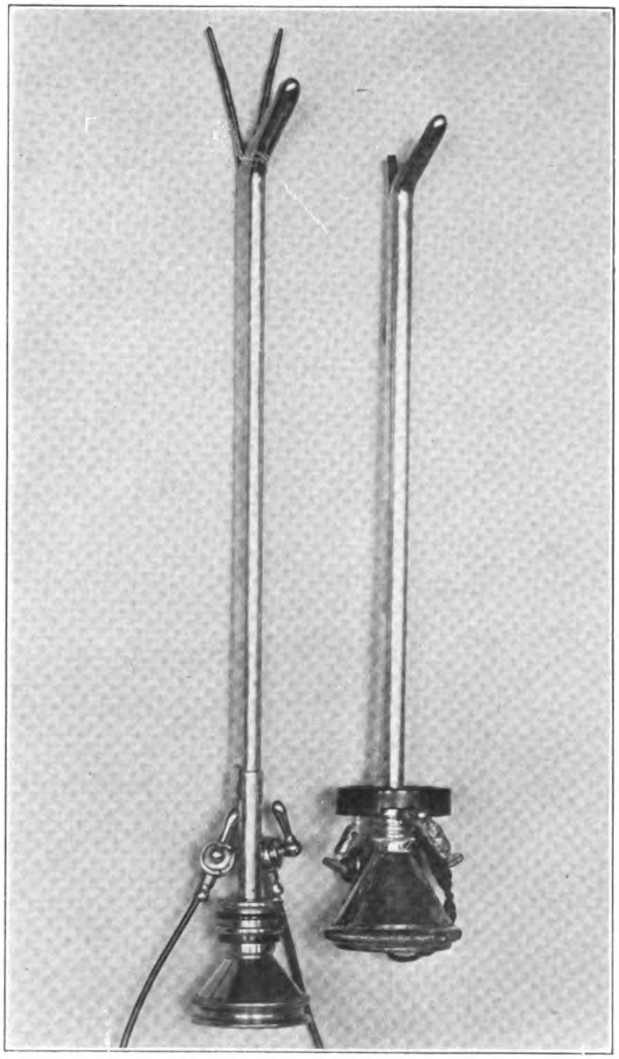


Fig. 124.—The Brenner and Brown catheterizing cystoscope with catheters emerging from instrument.

this may be followed from one side to the other and will lead to the openings. Another method is by holding the instrument in such a way that the vesical end points in toward the probable position of the ureter mouth. This can be done by moving the outer end of the instrument about three inches to the right or left of the median line and raising it about three inches above the horizontal, then withdrawing it slowly until the trigone comes into view and watching for the urinary efflux, which appears like a swirl of glycerin in a water medium (Fig. 86). If this has been colored by giving the patient methylene-blue or indigo-carmin, it may aid in the search.

If the medium has become clouded before the object has been accomplished, one of the irrigating cocks may be opened, the medium removed, and a fresh solution injected. Occasionally, the bladder contents are so foul that the ureter openings cannot be seen. In such a case the use of a continuous irrigation is indicated, which will keep the area clear immediately in front of the lens.

When the opening has been recognized the corresponding catheter is advanced until it comes into view, and is passed into the ureter for about three inches.

Holding the cystoscope in exactly the same plane, it is moved to the opposite side and the other ureter opening recognized and catheterized. Knowing the position of one ureter opening, it is much easier to find the other, for we know that, as a rule, it occupies the same relative position. The second catheter is advanced two or three inches. The instrument is then carried back to the median line, the plugs or caps removed, and the urines collected in separate test-tubes. As soon as urine begins to drop from the end of the catheter, the character and rhythm are noted. After the first thirty or forty drops have come through, a specimen is taken on a glass slide and examined. It is best to allow the distending medium to escape, at least in part. If desirable, the instrument may be removed, leaving the catheter in place, but it is safer to take a specimen for examination before this is done. For instructions in advancing the catheter and overcoming difficulties, see pages 180–181.

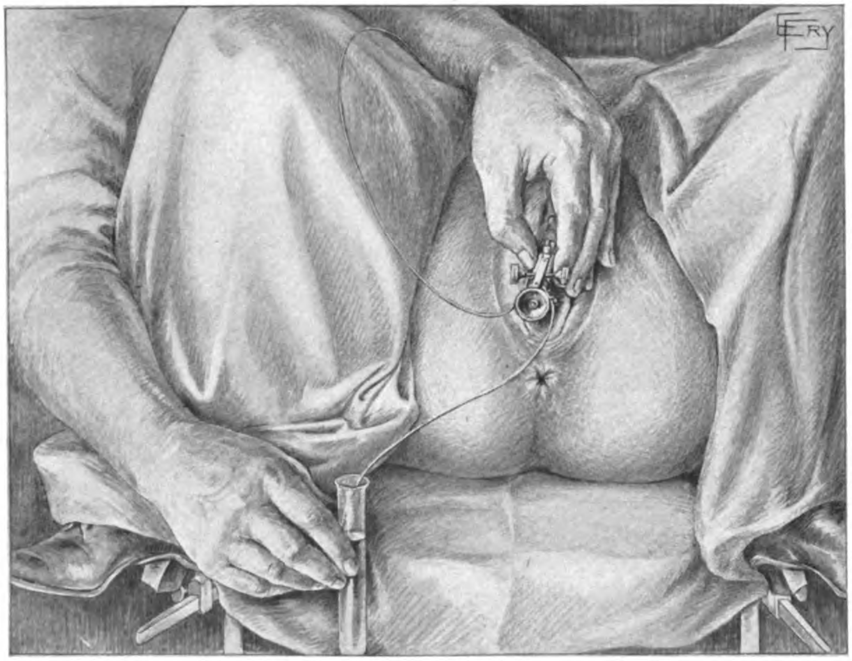


Fig. 125.—Collecting urine from the kidney with catheter and cystoscope in place. It is quite important that a specimen of urine be collected from the ureter first catheterized and examined immediately before catheterism of the second ureter is attempted. If this is done, many disappointments are forestalled, as bleeding from the ureter frequently occurs after any manipulation.

Removal of Instrument, Leaving the Catheter in Place.—The catheters are advanced as far as may be desired. Then, with an assistant holding the instrument, the washers are removed from the catheters, the telescope unlocked, and, holding the catheters with one hand, the telescope is gradually withdrawn over them. As soon as the telescope has been partially removed, the catheters are lifted out of the catheter canals, if possible. After the telescope has been removed, the sheath is slowly withdrawn, holding the catheters so that they will not be withdrawn with the sheath. If, after withdrawal of the instrument, the character of the droppings from the catheters is changed from a rhythmic, intermittent dropping to a steady, uninterrupted dropping, one may be sure that the catheter has slipped out of the ureter into the bladder.

After the catheter has remained in the ureter for a short time, it is molded so that it follows the curves of the ureter. When the catheter is removed, an inspection of it will usually show the exact shape and course of the ureter. This is sometimes of importance, (1) to indicate whether the catheter has really been in the ureter, and (2) to demonstrate any deviation in the course of the ureter.

Preventing Infection.—Before removing the catheter from the ureter, a small amount of ½ of 1 per cent. silver nitrate solution may be instilled. Urotropin is administered by mouth for a few days after the examination.

ANATOMIC DIFFICULTIES ENCOUNTERED

Variations in the Position of the Trigone.—Any variation in the position of the trigone affects the position of the ureter openings. There are two distinct types of bladder which are normally seen, (1) with a horizontal trigone, which is easy to work with, and (2) the vertical type of trigone, in which the trigone falls backward and away from the opening of the urethra, causing considerable difficulty in entering the catheter.

The Trigone and Ureter Openings in Disease.—In women with relaxed pelvic outlet, the bladder sags down, and, when a cystocele is formed, it sometimes becomes necessary to use an elevator in the vagina to lift the trigone up sufficiently to engage the ureter openings. In pregnancy or pelvic tumor the ureter openings may be considerably distorted. In men a hypertrophied lobe of the prostate sometimes grows out over the trigone, but usually lifts it up and pulls the ureter opening out of place. Increasing the amount of fluid contained in the bladder will often enable the operator to raise the trigone up sufficiently to see and catheterize the openings. In tuberculosis of the bladder and other inflammatory conditions considerable difficulty may be experienced on account of distortion or contraction of the opening. If the opening is small, a smaller catheter must be used, and it may be gradually dilated. In many cases of enlarged prostate the ureter openings cannot be seen.

CHAPTER II

TECHNIC WITH THE INDIRECT CATHETERIZING CYSTOSCOPE

Before introducing the instrument see—

(1) That the catheter deflector is in good working order.

(2) That the rubber washers which hold the catheters are tight enough to prevent leakage from the bladder.

(3) That the catheters are lubricated.

(4) That there is a good illumination and a clear medium to work in.

After introducing the cystoscope and finding that the light is sufficient and the medium clear, the cystoscope should be withdrawn until the border of the urethral sphincter comes into the field; then the instrument is advanced a little and the beak slowly revolved to the right through an arc of about forty-five degrees and the left ureter opening will appear in the field. Turning it again in the opposite direction through an arc of eighty to ninety degrees, the right ureter opening will be seen. In using the American cystoscope of the latest design, it is often possible, by raising the beak of the instrument, to observe the position of both ureter openings at the same time.

When the ureter opening has been found, the cystoscope is held in such a position that the catheter will travel as nearly as possible in a straight line through the shaft of the instrument and up the ureter. In catheterizing the right ureter of a patient the ocular end of the instrument is carried about three inches to the operator's right and slightly lifted from the horizontal plane; then, with the ureter opening in view, the catheter is advanced so that its tip passes across and a little beyond the field of vision (Figs. 126 and 127). This is about one inch. The deflector is then raised,

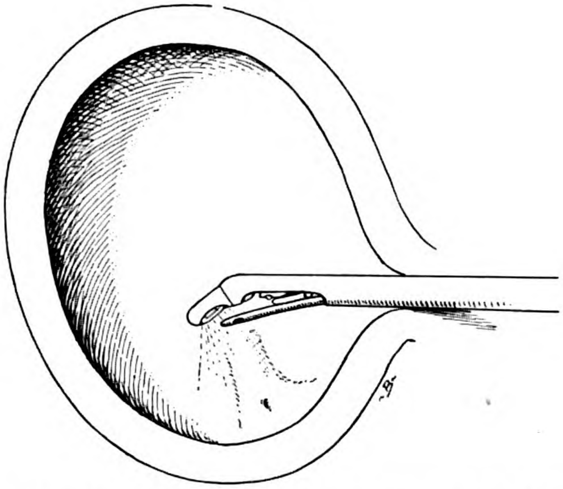


Fig. 126.—Normal ureter catheterism, second step (Buerger).

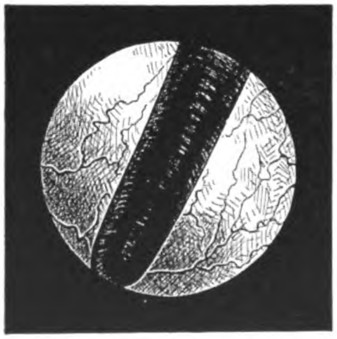


Fig. 127.—Cystoscopic picture showing end of catheter lying near the lens of the instrument.

which brings the point of the catheter again into the field (Figs. 128 and 129). As the catheter is raised up, it will be noted that it appears smaller than that portion which is nearer the lens. As soon as the point of the catheter lies over the ureter opening, the instrument itself may be slightly advanced and the ocular end of the instrument raised so that the tip of the catheter becomes

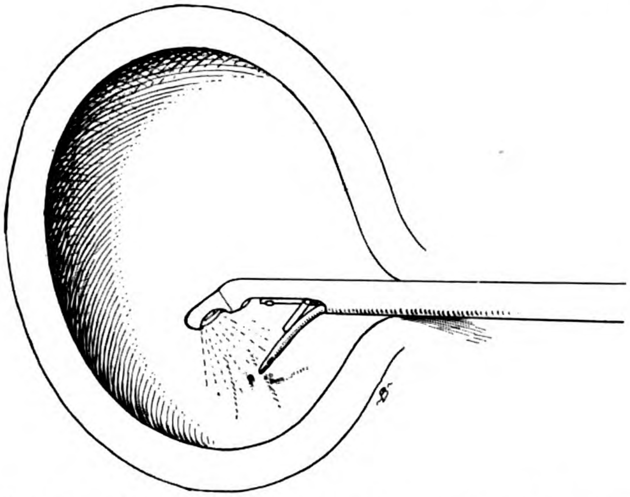


Fig. 128.—Normal ureter catheterism, third step (Buerger).

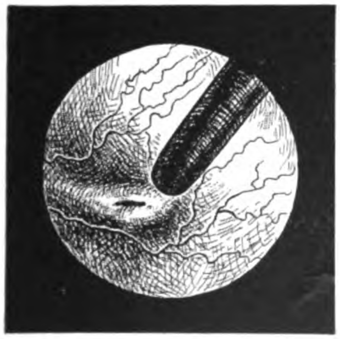


Fig. 129.—Cystoscopic picture showing end of catheter slightly elevated.

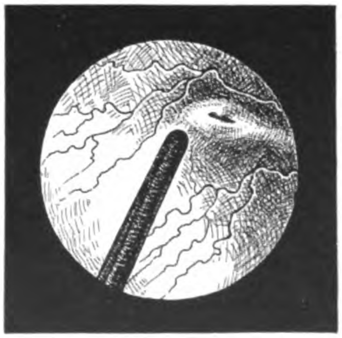


Fig. 130.—Cystoscopic picture showing catheter near ureter opening.

engaged in the opening of the ureter (Figs. 131 and 132) then the catheter is advanced about three inches (Fig. 133). The proximal end of the catheter is then given to the assistant to hold. The deflector is lowered and the other ureter opening is located and catheterized in a similar manner (Figs. 134 and 135).

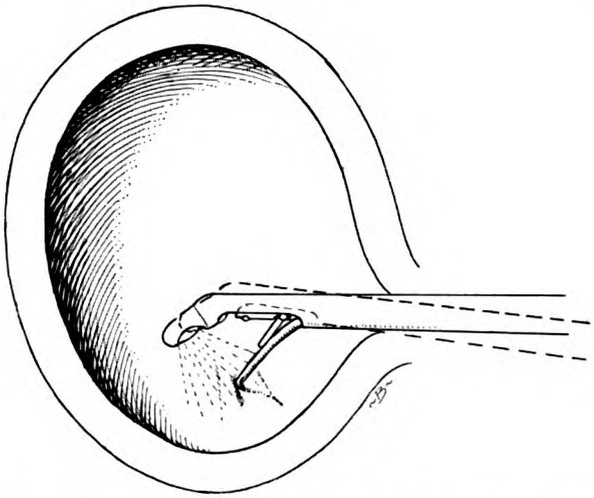


Fig. 131.—Normal ureter catheterism, fourth step (Buerger).

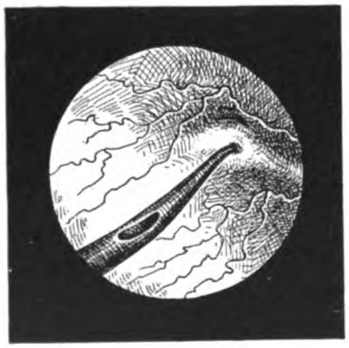


Fig. 132.—Cystoscopic picture showing catheter entering ureter opening.

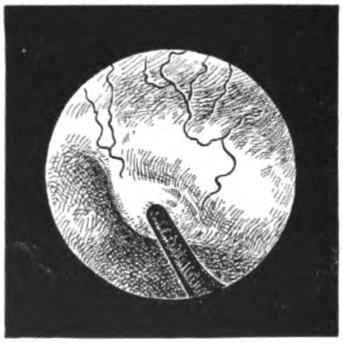


Fig. 133.—Cystoscopic picture showing catheter advanced into ureter

In using the Buerger instrument (see page 175), it is introduced with the obturator in place. Then the obturator is removed and the large prismatic observation telescope is introduced. It is best to use this telescope first in order to study carefully the condition of the bladder and the position of the ureter openings. The field of vision is unusually clear. After this study has been completed, the telescope is withdrawn and the catheter telescope, with the catheters in place, is introduced, just as is done in using the Brown direct cystoscope. The direction and elevation of the catheter can be controlled entirely by raising or lowering the deflector. Frequently it will be found that, even with the instrument supposedly in a correct position, the tip of the catheter will not enter the ureter opening, and it is necessary to change the position of the instrument in order to alter the direction of the approach of the catheter, first attempting to enter the opening from one side and then from the

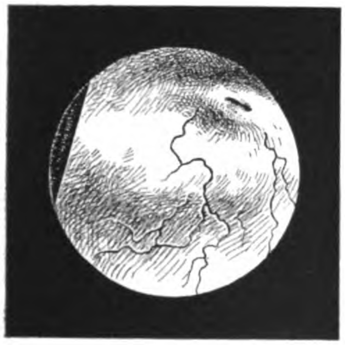


Fig. 134.—Cystoscopic picture, bringing the second ureter opening into view.

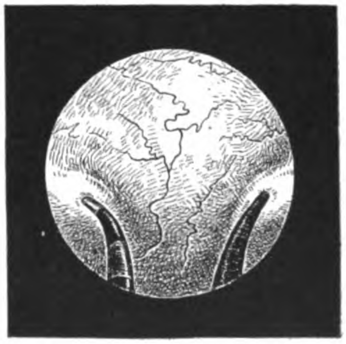


Fig. 135.—Cystoscopic picture showing both catheters entering ureters.

other, and with the catheter sharply bent and only slightly curved. These things, however, can only be learned by experience. After the catheter has been advanced for about an inch within the opening the deflector is turned down somewhat, so as not to bend the catheter too sharply in advancing it. If it is desired to use the Buerger instrument for observation, the examining telescope with a very large field of observation may be introduced into the sheath before using the catheter telescope. In fact, the sheath is practically a large, illuminated, evacuating catheter, and any combination of telescope may be used within it.

How Far to Advance the Catheter.—For diagnostic purposes it is usually necessary to advance the catheter two to three inches. For therapeutic use it is often essential to pass the catheter to the pelvis of the kidney, which should be done slowly at all times. If it is desirable to remove the instrument, leaving the catheter in place, the catheter telescope is first removed, using the same precautions as indicated for removing the catheter telescope from the direct catheterizing instrument, and then the sheath is removed by depressing the ocular end, turning the beak of the instrument up, raising the ocular end, and gradually withdrawing the instrument, as in the accompanying illustration (Fig. 136).

Advancing the Catheter.—In many instances it is best to leave the lever partially raised while advancing the catheter; in others, it is better to partially or entirely lower the lever; sometimes it is necessary to try various methods in order to advance the catheter without causing pain. Kapsammer advises that the catheter be advanced only between the periods of ureteral contraction, because, during the contraction, the catheter may be held tightly within the canal; otherwise injuries may be suffered by the mucous membrane, causing slight bleeding which would obscure the findings of the examination. The tendency is to advance the catheter rapidly as soon as it has entered the ureter, but this should never be done. The ureter contractions are often stimulated by the presence of the catheter in the ureter, being simply an effort on its part to expel the foreign body. *Never put out the lamp while advancing the catheter, and always advance the catheter entirely under the control of the eye.*

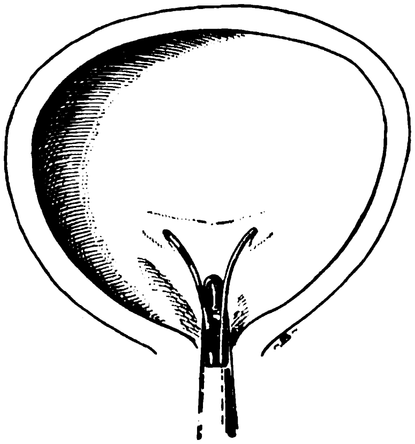


Fig. 136.—Removal of sheath of cystoscope.

When the catheter is in place, the lever is lowered, the lamp is turned out and the urine collected.

Signs of Having Reached the Pelvis.—The normal length of the adult ureter varies from 25 to 45 centimeters, the average being 27 to 35 centimeters. When the catheter has been advanced 28 to 30 centimeters and the portion within the bladder is seen to bend as if there were an obstruction ahead, it is safe to surmise that the end of the catheter has reached the pelvis of the kidney and has struck against the papillæ.

Length of Time for Leaving Catheter in Place.—The catheter may safely be left in place for diagnostic purposes for from one to two hours. For surgical purposes and for continued drainage of the renal pelvis, the catheter may be left in place for days.

When Bleeding Occurs.—If the catheter be advanced a little, it will probably pass over the bleeding-point. If the catheter becomes clogged, fluid may be injected and the catheter pushed higher up. If the mucous membrane of the ureter is congested or inflamed, the catheter must be advanced very slowly to avoid hemorrhage. When bleeding occurs, very little can be done to check it.

Causes of Obstruction to the Passage of the Catheter.—(1) Contraction of the walls of the bladder or ureter; this is seldom of any moment and is overcome by waiting a short time.

(2) A narrow ureter opening may necessitate the use of a smaller catheter. A sharp curve in the ureter may call for the substitution of a softer catheter.

(3) Pathologic conditions, such as distortion or compression of the ureter.

(4) A narrow stricture.

(5) Occlusions of different kinds, such as a tumor or inflammatory mass pressing on the ureter, a calculus impacted in the ureter, etc.

Character of the Droppings from the Catheter.—The urine passing from the catheter comes in drops which occur at varying intervals. There is no absolute rule.

The fluid drops from the catheter continuously when the end of the catheter lies in the bladder. When the end is in the ureter the drops of urine come rhythmically, under normal conditions, corresponding to the contractions of the ureter, each contraction being followed by three or four drops from the end of the catheter. When the eye of the catheter is in the upper part of the ureter the rhythmic drops are often continuous; this is also true if the opening of the catheter be within the pelvis of the kidney. There

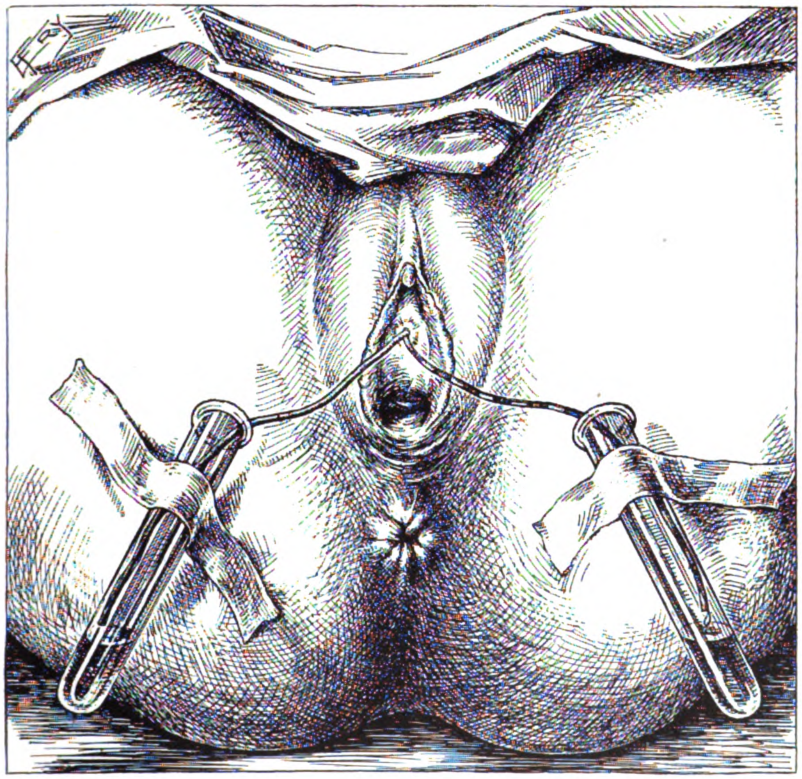


Fig. 137.—Collecting urines from each kidney separately after instrument has been removed.

may be deviations from the normal type, it being not infrequent that nothing flows from the catheter after its introduction into the ureter. The most frequent cause of this is reflex anuria. As a rule, the reflex anuria lasts only five or ten minutes. A plugging of the catheter or the contraction of the ureter closing down upon the opening of the catheter makes it impossible for the urine to pass through. An increase in the output from the kidney may be occasioned. If the reflex anuria or oliguria continues for an hour, we assume that there is some anatomic lesion as the basis of the functional disturbance of the kidney. If the catheter be stopped up, the urine may be observed to flow out beside the catheter, and under these conditions it is better to withdraw the catheter into the bladder, force out the obstructing plug, and then return the catheter to the ureter. Occasionally, very irregular droppings will be observed, and Kapsammer ascribes as a reason for this the strong bladder contractions causing a regurgitation of urine into the ureter and, in turn, out through the catheter. It is also seen in pyonephrosis and in cases of ureteral calculi. In cases of polyuria we usually see an irregular, continuous dropping. In cases of a continual flow of clear urine, it may also be due to hydronephrosis. The flow from a dilated ureter is similar to that from the renal pelvis.

CHAPTER III

URETER CATHETERISM THROUGH OPEN ENDOSCOPIC TUBES

WITH THE KELLY TYPE OF ENDOSCOPE

KELLY introduced the method of direct cystoscopy through open endoscopic tubes in the year 1894, and was the first to demonstrate the method in this country (Figs. 59 and 138). Pawlik, about the same time, perfected an instrument for the same purpose based on the principle of the Nitze-Obalander urethroscope. A number of similar instruments with minor modifications have been presented by Cullen, Luys, and others, using different methods of illumination. The basic principle, however, has been the same.

The Technic of Ureter Catheterism.—The main features of this method are:

(1) The gradual dilatation of the urethra by sounds.

(2) The introduction into the urethra of a small, straight endoscope, without lenses.

(3) Dilatation of the bladder by air, which takes place with the patient in a knee-chest or Sims' posture.

(4) The examination and location of the ureter openings by reflected light, or a small electric light at the end of a carrier introduced through the endoscope.

Instruments Required.—A urethral dilator and endoscope with obturator, a metal or rubber tube for keeping the bladder free of urine, a long pair of mouse-tooth forceps, a searcher for locating the ureteral orifices, and a ureteral catheter. An adequate source of illumination is necessary.

Conducting the Examination.—The recommendations of Kelly are as follows: The patient is instructed to pass her water immediately before examination. As a rule, however, there is always a small residual urine remaining.

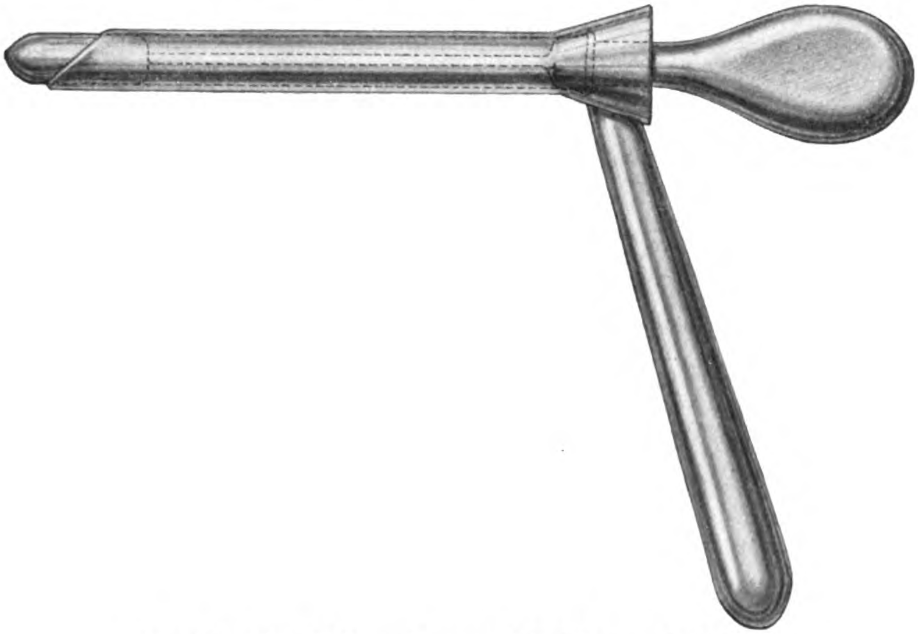


Fig. 138.—The Kelly endoscope with oblique end (Kelly).

The patient is then placed in the knee-breast posture; occasionally, the Trendelenburg or Sims' posture may be used. This raises the pelvis of the patient higher than the shoulders and throws the abdominal contents away from the pelvis (Fig. 142). The first portion of the urethra is anesthetized with a 20 per cent. solution of cocain, or by injecting a weaker solution of cocain into the deep urethra. The urethral orifice is dilated by using graduated sounds or a cone urethral dilator (Figs. 140 and 141) until it is large

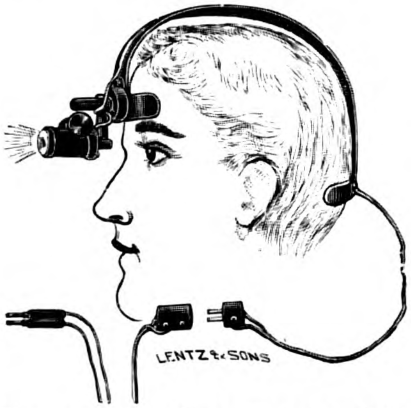


Fig. 139.—Headlight used by Kelly for illuminating bladder.

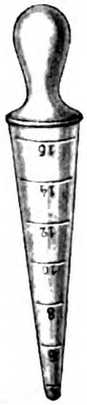


Fig. 140.—Cone urethral dilator (Kelly).

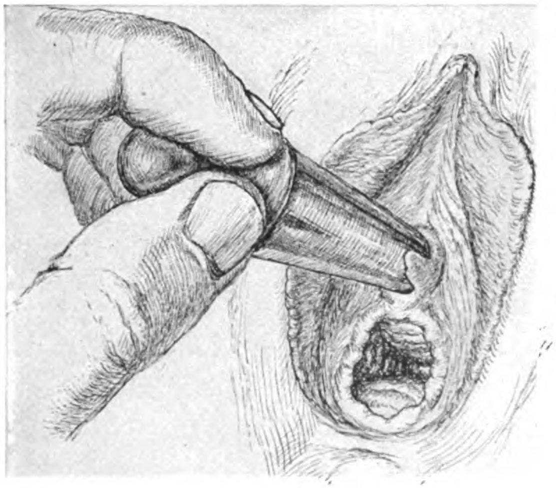


Fig. 141.—Dilating external urethral orifice with Kelly cone dilator (Kelly).

enough to admit the obturated endoscope desired. In many cases, especially in patients who have borne children,

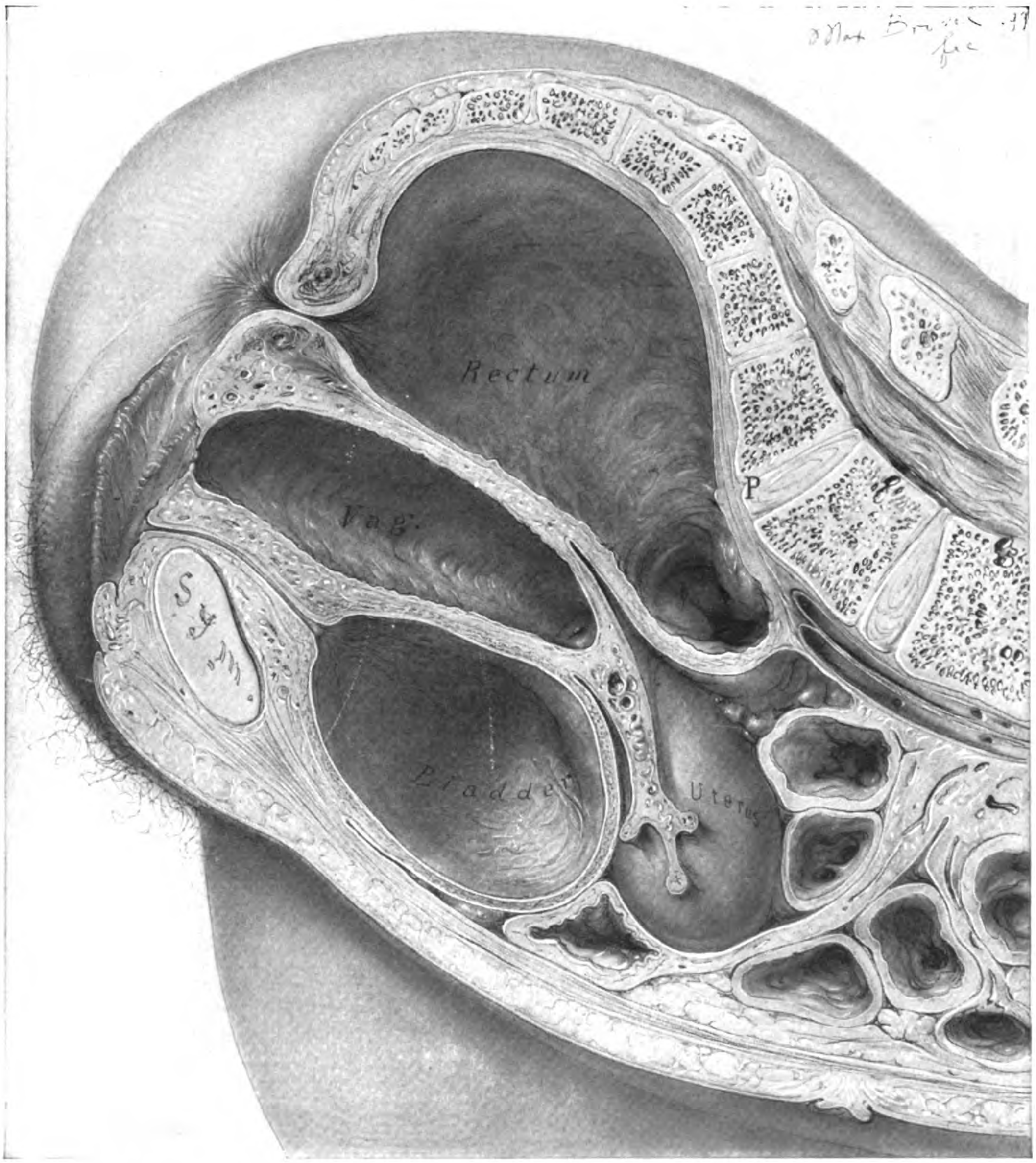


Fig. 142.—Median section of pelvis with patient in knee-chest posture (Kelly-Noble).

very little dilatation is necessary. The endoscope, with obturator in place, is then introduced into the urethra, the obturator withdrawn, and air rushes in and distends the bladder. In stout women the air distention will not take place unless the knee-breast posture has been assumed. The bladder is illuminated through the speculum, any residual urine is evacuated, and the ureter openings are sought.

The normal mucous membrane appears as a dead white surface upon which are seen small blood-vessels running in various directions. The handle of the speculum is lowered, which brings the interureteric band into view showing as a faint elevation on the base of the bladder. This is not very far from the internal urethral orifice. The ureteral openings are readily seen by turning the speculum through an arc of thirty degrees from the median line. The openings appear as slits, or horseshoe-shaped folds, with their convexities outward. If the bladder is not very markedly distended, the openings occupy a slight prominence or mound, and the mucous membrane lining them appears to be deeply congested. Small jets of urine may be seen spurting into the bladder.

Catheterizing the Ureters.—With the ureter opening directly in the field of vision, it is first wiped off with a swab of cotton, then a ureter catheter is passed through the endoscope and entered into the ureter opening and advanced as far as desired. Kelly claims that the ureteral orifices are so easily found after a little practice that it is not always necessary to elevate the hip and distend the bladder in order to catheterize them. It is only necessary to introduce the speculum, elevate and turn the handle to the point where the ureteral orifice should be found, then by pressing the inner end down against the bladder wall the urine is excluded and the ureteral opening will often be found without trouble within the lumen of the speculum. There are occasional depressions and false diverticula in the bladder which look like ureter openings. These can be differentiated by using a small metal searcher.

Kelly uses this method—

(1) For the collection of urine directly from the ureter without being contaminated by the contents of the bladder.

(2) To determine the presence of both kidneys.

(3) To determine the existence of disease in the ureter.

(4) To place a solid catheter in the ureter as a guide during abdominal and pelvic operations.

We do not advocate the use of this instrument, for it causes unnecessary suffering and has no advantage over the cystoscope.

URETER CATHETERISM WITH THE ELSNER AND BRAASCH TYPE OF CYSTOSCOPE

Preparation of the Instrument.—The three parts of the instrument are the sheath, which contains the lamp and the catheter canals in its floor, the obturator, and the glass window. The sheath is placed in 95 per cent. solution of carbolic acid, then washed off with sterile water. The obturator and the glass window are sterilized by boiling. The ureteral catheters are sterilized by boiling in clear water for a minute.

Technic of Examination.—The patient is placed on a table in the lithotomy position. The parts are carefully cleansed with soap and water, and some mild antiseptic; local anesthesia is usually necessary. The cystoscope is taken from the carbolic acid solution and rinsed in sterile water. The obturator is introduced, the light is tested, the strength of the current is regulated and then connected before the instrument is introduced. The urethra is filled with sterilized glycerin, and the instrument is introduced. After it has reached the bladder, the obturator is removed, and whatever urine there is in the bladder is allowed to escape. If desirable, the bladder may be washed out and cleansed before the instrument is introduced.

After the obturator has been removed, the glass window, which has been boiled and dried on a sterilized towel, closes the opening from which the obturator has been withdrawn. An irrigating cock in the side of the sheath is attached to a jar containing sterile water. This is opened and water is allowed to pass through the sheath into the bladder, which is distended by it. Rubber tubes are attached to the catheter canals and water flows out from the bladder through this. To stop the outflow of water, the tubes are simply compressed against the rim of the ocular end of the instrument. When everything is in position, the light is turned on. Either air or water may be used to distend the bladder. With the instrument in place the operator looks through the glass window and locates the trigone. Turning the ocular end of the instrument to the operator's right, the right ureter opening comes into view and normally appears as a slightly raised portion of the bladder wall in the center of which is seen the ureter opening with slightly reddened borders. The character of the urine coming from the opening is then noted. Also the force and time of appearance, and whether or not there is contraction of the muscles. The shape, size, and general morphologic characteristics are studied, noting the presence or absence of hyperemia, swelling, edema, vesicles, ulcers, or hemorrhagic spots, varices, etc. It is important in using this type of cystoscope to keep a continuous positive pressure of water on the telescopic tube. It is better, also, to have a little water flowing in from the outside and a little flowing out through the catheter tubes. If a backward flow takes place through the tube, the picture will be blurred. With the distending fluid slowly entering the bladder, the ureter opening is identified, and an assistant then brings the sterilized ureter catheter, grasping the end of it in a pair of sterilized forceps and holding the proximal end in his hand. The rubber tubing is removed from one of the catheter canals and, using the sterilized forceps, the catheter is inserted through this canal. Then it is taken by the operator and, with the ureter opening in sight, is guided into it. Slowly, and with the opening always in view, the catheter is passed up through the ureter as far as is desired. If one wishes to collect only a small amount of urine, the catheter is passed only about 10 cm. If it is desired to determine the presence or absence of an obstruction in the ureter, the catheter is passed further upward. If the catheter meets with an obstruction before it has passed 27 cm. through the ureter, one can be sure the obstruction lies within the ureters. The above is a description of the method employed by William Braasch, of Rochester, Minn.

CHAPTER IV

THE DIAGNOSTIC VALUE OF URETER CATHETERISM

It is not always possible by inspection alone to determine definitely the presence or absence of a ureter opening. This is especially true in old trabeculated, pitted bladders in which there are many openings. With the catheter or sound we can, however, differentiate between these. When the orifice has been definitely located, the patency of the mouth can be determined by introducing a catheter. It may be that the contractions of the opening temporarily retard the advance of the catheter, but, as a rule, when the instrument is held in the proper position, the catheter can be advanced unless there is some constriction of the meatus. Aside from strictures, the ureter may be obstructed from within by a foreign body, such as a calculus, or from without by tumors, constricting bands, kinks, or abnormal blood-vessels. In passing a stone in the ureter, the obstruction feels hard, and when the catheter passes it, it causes pain and there may be a sense of roughness or grating. If wax is used to tip the catheter, characteristic scratch-marks are found on the wax. A tumor from without gives the sensation of something binding the catheter, which advances slowly. When an abnormal vessel crosses and binds down the ureter near the renal pelvis, the catheter meets a soft obstruction which it passes without any sudden jump, as may be experienced in passing a stone.

If the ureter is dilated, as in pregnancy and certain spinal diseases, the ureter mouth is seen to sag or gape, and, as the catheter advances, one side of the opening stretches so that the instrument is seen to incompletely

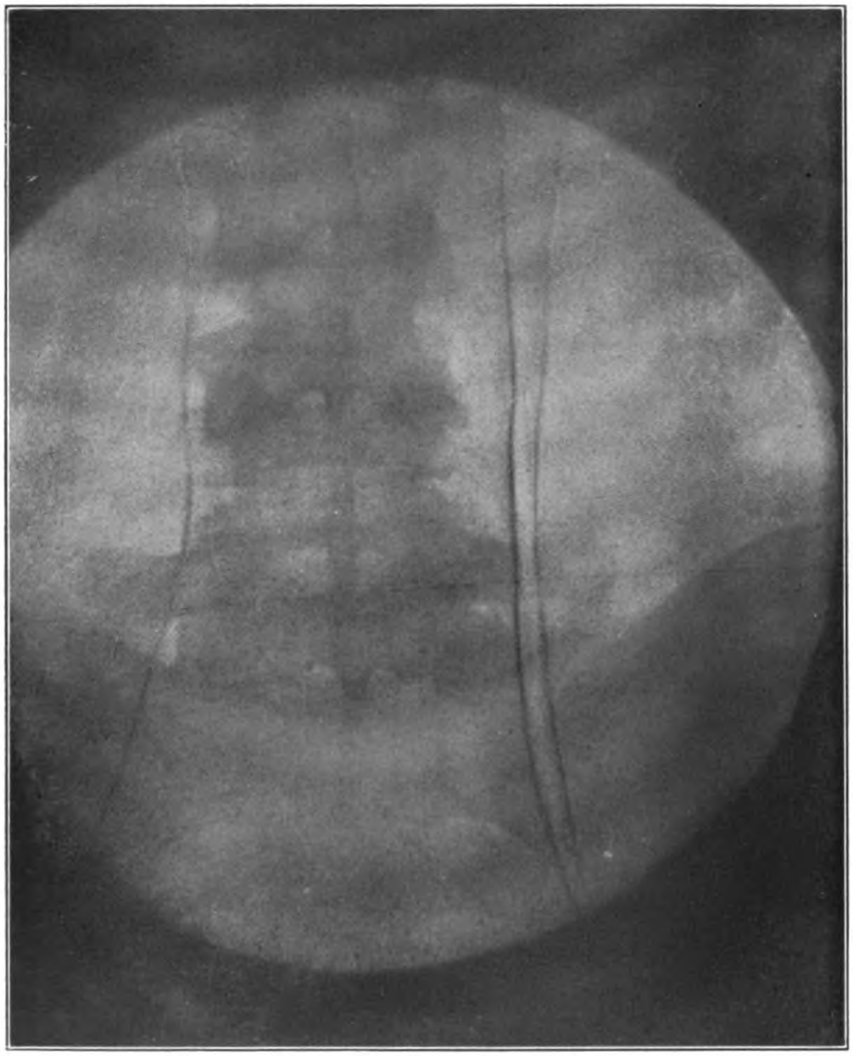


Fig. 143.—*x*-Ray picture showing three ureters with wire stilets in place (Brown).

fill the opening. In such a condition two or more catheters may be introduced at the same time. When the opening is obstructed or contracted by disease, a dilatation of the upper portion of the ureter may be shown by finding a greater or less amount of residual urine above the point of constriction.

The conformation of the ureter may be determined, for a silk catheter, after remaining in the ureter for a short time, is so molded that when it is withdrawn it retains the shape of the tube in which it has been lying. I have been able to demonstrate this by comparing the catheter after its removal with an *x*-ray picture taken while it lay in the ureter.

Ureterographic and pyelographic pictures may be obtained by using a wire stilet, as already described, or by injecting through the catheter a bismuth solution or collargol solution. In using a stiff catheter great care must be used in advancing it in order to avoid injuring the ureter, especially if it is the seat of disease.

The ureter catheter finds its greatest usefulness in the diagnosis of diseased conditions of the kidneys, and in determining the functional activity of a healthy or diseased kidney. It makes possible synchronous collection of the urine from each kidney separately. Not only can we discover pathologic conditions, but we can also determine deformities of the renal pelvis, the degree of a hydronephrosis, and differentiate between renal colic and pain due to other causes. The details of these examinations will be taken up later.

PART II

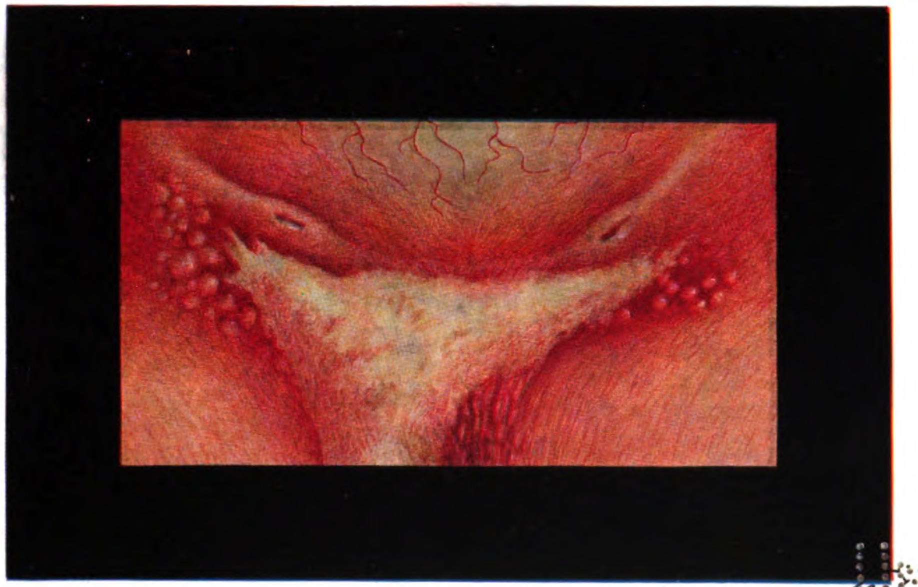
THE DISEASED BLADDER

INTRODUCTION

THE diseases which affect the interior of the bladder do not differ very much from those which affect the mucous membrane lining any other cavity or orifice of the body. The degrees, characteristics, and extent of the pathologic processes are not materially affected by the presence of urine constantly passing over their surface, with the exception that, under certain conditions, the salts of lime, urates, and phosphates, may deposit upon an eroded surface and change the appearance of the same. This, however, is simply a mechanical difference.

Precautions in Conducting an Examination.—In all conditions of the bladder where any disease is suspected, a metallic or hard instrument should not be introduced when the walls of the bladder are totally collapsed, on account of the injury which may be done to the inflamed surface. In washing the bladder, small amounts of fluid should be used. The fluid should be non-irritating, warm, and introduced without much pressure. The most successful way to prepare a bladder for examination is by first introducing a soft-rubber catheter, washing the bladder, introducing the medium, withdrawing the catheter, and then introducing the cystoscope. After the cystoscope

PLATE IV



Edema Trigoni Membranosum (Pilcher).

The receding stage of a severe cystitis. Trigone is congested, inflamed, lumpy, and is covered by a tenacious grayish-white membrane which peels off easily, leaving a raw, bleeding surface. Hematuria and dysuria characterize this condition.

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has been introduced, it should not be moved about until the light has been turned on and the exact position of the instrument determined. By observing these simple instructions, one may avoid troublesome hemorrhage and be able to conduct an examination in an inflamed bladder where, without these precautions, it would be impossible to do so.

Character of the Changes which may Take Place in the Bladder.—Pathologic conditions may exist as the result of nerve lesions, changes in the blood-supply, infection, or as the result of injury, either mechanical, thermal, or chemical. Benign and malignant tumors, foreign bodies, cysts, vesicles, and abnormalities of development are frequently encountered.

Site of Disease and Distribution.—The most frequently affected portions of the bladder, in the order of their occurrence, are the vesical neck, the trigone, the base of the bladder, the ureteral openings, the fundus of the bladder, the lateral walls of the bladder, and the vertex. Any portion of the bladder may be the site of disease. One portion may be acutely inflamed and the remaining portion perfectly healthy. There may be single points of infection, or there may be multiple foci with areas of entirely healthy tissue intervening. An area diametrically opposite a point of infection or inflammation which comes in contact with the diseased portion when the bladder is empty, may become similarly involved.

Conditions Seen which Simulate Disease of the Bladder.—When the bladder is empty the size and caliber of the blood-vessels change so greatly that the surface of the bladder when viewed through the cystoscope, when distended and when empty, shows very distinct differences in color, varying from a dull red when the bladder is empty to a glistening white, with a little rose color, when the bladder is distended. The amount of light used to illumine the interior of the bladder makes considerable difference in the appearance of the mucous membrane. A dull light will give to the folds of the bladder a dull, reddish, inflamed appearance which entirely disappears when the light is stronger. If anything smears over the prism of the telescope, such as a blood film, the mucous membrane may appear to be intensely inflamed, or a purulent exudate may obscure an inflamed surface. Rugæ, or folds of mucous membrane, seen when the bladder is relaxed, resemble in appearance the surface of an inflamed growth, while when the bladder is distended the surface will be seen to be perfectly normal.

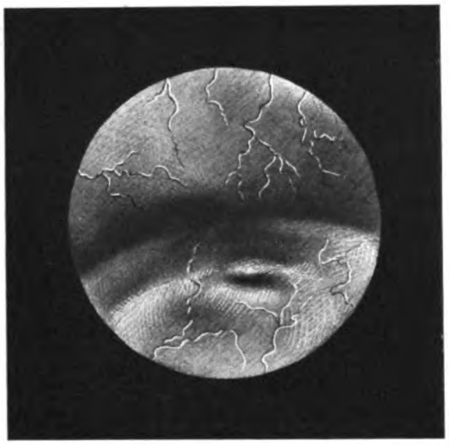


Fig. 144.—Cystoscopic picture showing fibroid uterus pressing into the bladder.

Any abnormal condition in the neighborhood of the bladder may cause distinct symptoms simulating very closely bladder disease.

Extravesical Tumors.—For example, tumors occupying the pelvis, especially fibroid tumors of the uterus, frequently encroach upon the lumen of the bladder, but they are easily differentiated by the absence of any pathologic change in the overlying mucous membrane (Fig. 144). Impacted feces, or a pregnant uterus, may, without causing distinct pathologic changes in the bladder, give rise to pressure symptoms (Fig. 145).

Staining by Drugs.—Certain changes may be seen which are due to staining by drugs, such as the grayish-black appearance from silver nitrate, and the green discoloration from the use of methylene-blue.

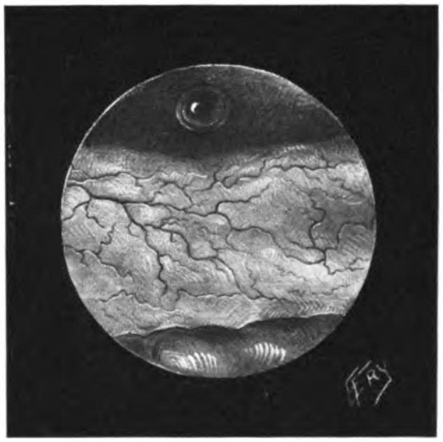


Fig. 145.—Cystoscopic picture showing pregnant uterus pressing into the bladder. In the foreground of the picture the swollen urethral orifice is seen; above this, the mucous membrane of the bladder with veins dilated reaching almost to the vault of the bladder, which is indicated by the air bubble seen at the top of the picture. It is under such conditions that the ureter becomes compressed at its lower end.

Irregularities of the Vesical Neck.—Aside from the changes due to prostatic overgrowth there are certain irregularities in the mucous membrane seen more especially in women. I refer to the polyp-like excrescences which hang down around the vesical neck. These structures are very delicate in formation and are transparent, often containing a delicate loop of blood-vessels which can be plainly seen through the cystoscope. They are in no way pathologic and should never be considered as such (see Fig. 81, page 119).

Distended Mucous Crypts.—Occasionally we see on the surface of the trigone, near the urethral sphincter, small, raised-up, cyst-like processes, which show no inflammatory changes, and appear to be of considerable size. They are, however, insignificant, and are exaggerated by the nearness of the lens to the surface viewed. In reality they are simply distended mucous crypts (Fig. 146).

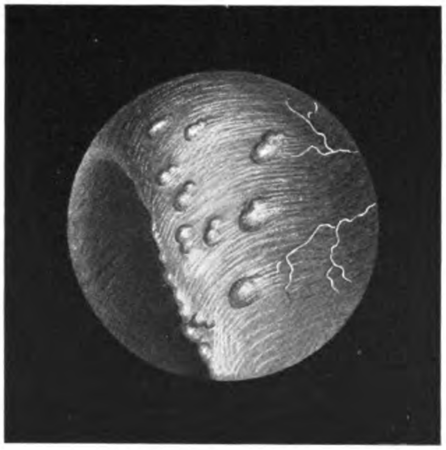


Fig. 146.—Cystoscopic picture showing mucous crypts at the neck of the bladder.

Variations in Muscular Structures. — Many variations may be noted in the muscular structure of the walls of the bladder which cannot be considered pathologic, but the formation of trabeculæ or thickened muscular bands in a young person should be considered as an indication of some obstructive disease. The muscular walls of the vesical portion of the ureter may also be hypertrophied and appear, from the interior of the bladder, as a distinct ridge, but the absence of overlying edema of the mucous membrane should differentiate it from a cystic formation or an impacted stone in the ureter (Plate III, opposite p. 124).

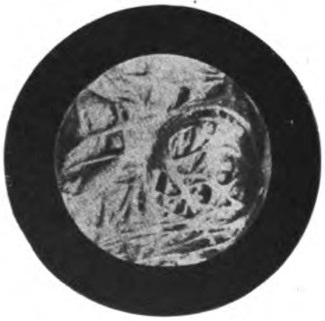


Fig. 147.—Trabeculated bladder wall with false diverticula.

CHAPTER I

PATHOLOGIC CHANGES

CHANGES SEEN IN THE LINING MEMBRANE OF THE BLADDER

Hyperemia.—We may have either an active or a passive hyperemia. An *active hyperemia* is the result of an increased afflux of blood into the parts, with resulting congestion. It most frequently arises from bruising, the action of heat, the irritation of drugs, the diminution of pressure on the blood-vessels, or the beginning or receding stage of inflammation. Viewed through the cystoscope the arterioles are seen engorged with blood, the picture differing in no particular from hyperemia of any mucous surface. This condition is frequently seen confined to the trigone. It may be due simply to extravesical causes, such as pregnancy, the pressure of a tumor, cystocele, a protracted cystoscopic examination, or other instrumentation. The point of distinction between a simple hyperemia and an infectious hyperemia is principally one of degree. When normal mucous membrane may be distinguished between the innumerable capillary branches, cystitis is said not to exist. In most pathologic conditions of the kidney pelvis, including tumors, a hyperemia of the corresponding ureter opening is generally seen. In almost all forms of tuberculosis of the bladder, hyperemia at the branching points of the arterioles is one of the earliest symptoms.

Passive hyperemia is seen when the flow of blood in the veins is obstructed, causing a blood stasis. The condition is generally due to compression, thrombosis, pregnancy, or the pressure of a pelvic tumor; the veins are distended and the hyperemic area appears cyanotic; there is always some swelling of the surrounding tissue.

Anemia.—Localized ischemia is of rare occurrence in the bladder, but is occasionally seen, due to some interference with the blood-supply either of mechanical or nervous origin. It has also been observed when a tumor presses into the bladder, limiting the arterial supply by direct pressure. The tissue becomes pale or white and may degenerate and die. If the pressure is long continued, or the arterial obstruction is not relieved, we have an extravasation of blood and the production of a hemorrhagic infarct. The extravasation appears as a blotch of dark red on the surface of the bladder.

Edema and Swelling.—Swelling due to infiltration of the tissues almost always accompanies hyperemia. It may be due to change in the blood-supply, to pressure, or to inflammatory causes. Edema may occur without the preceding stages of hyperemia, and may be caused by pressure from without or within the bladder, or may be present in inflammatory conditions in the neighborhood of the bladder. The surface of the bladder is uneven, pale, and glassy, and the tissue looks succulent and is raised up above the level of the surrounding mucous membrane; the surface does not bleed easily when touched. There may be here and there isolated, transparent prominences resembling polyps. Such a condition is seen most frequently on the trigone as an early symptom of carcinoma of the bladder and in all inflammatory conditions of any great severity. One of the most frequent causes of localized massive edema is an impacted or descending stone in the vesical portion of the ureter. Here the edema is massive and entirely obscures the ureter opening. With stricture and in pregnancy there is frequently an edema of the vesical neck. Occasionally, ecchymoses of varying grades are seen in connection with the edema. A strongly alkaline urine, residual urine, foreign body in the bladder, extravesical pressure, mechanical obstruction, and trauma following injury or operation, and inflammation, give rise to various grades of edema.

Edema Bullosum.—This lesion has been described as a separate pathologic entity by various observers. The writer has occasionally seen this condition in the bladder, but it has always been associated with some form of irritation or pressure. The most marked case which I have seen occurred in a case of aggravated tuberculosis of the bladder, not in the region of the ulcerations, but on the opposite wall of the bladder. In a second well-marked case it was due to an intense cystitis localized on the base of the bladder. It is seen sometimes surrounding the vesical opening of a fistulous tract, and in carcinoma of the uterus and prostate. The surface affected is usually well outlined, is distinctly elevated above the surrounding wall of the bladder, and is markedly edematous; the edematous mass

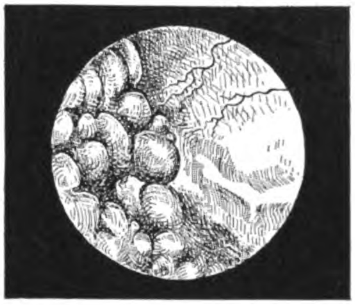


Fig. 148.—Adenoids of the neck of the bladder. (Redrawn from Kneise.)

is made up of numerous capsule-like vesicles which protrude into the bladder, resembling very much a bunch of grapes hanging on the surface; or it may be more flattened out, appearing like so many translucent, succulent polyps of a reddish-white color, covered by a smooth, glistening, non-inflammatory epithelium. The appearance is very typical, and is not easily confused with any other condition (Fig. 149).

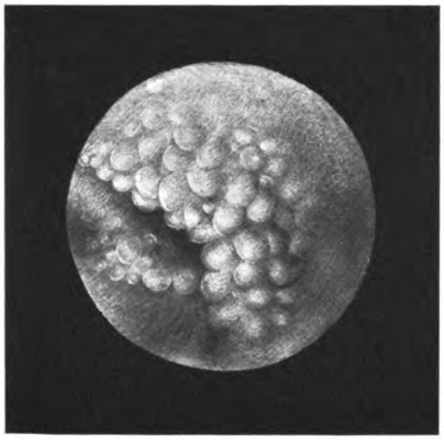
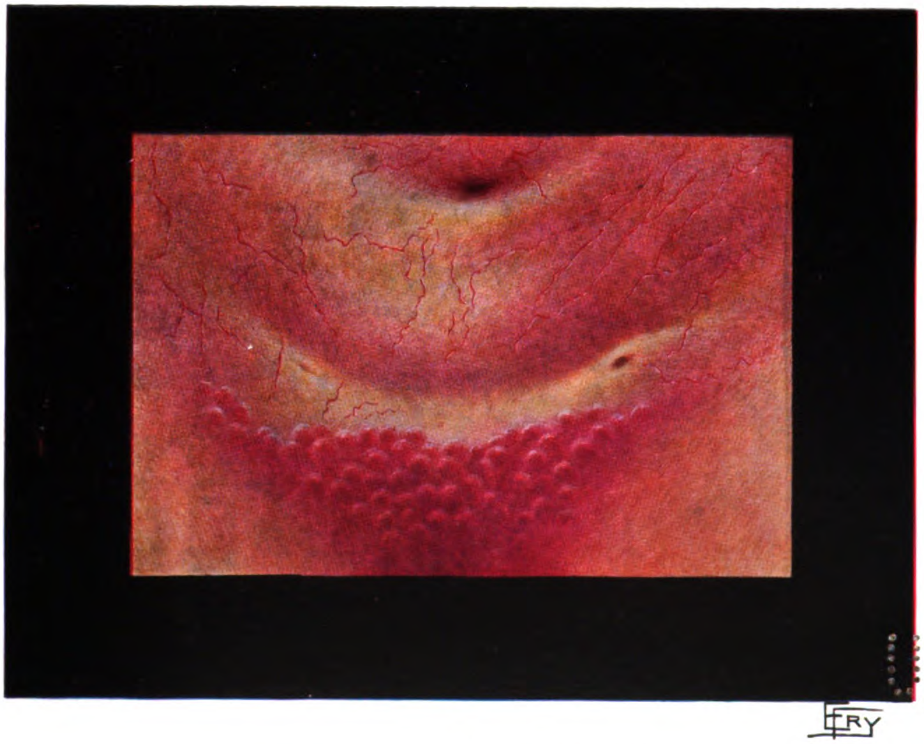


Fig. 149.—Cystoscopic picture showing edema bullosum.

Edema Trigonis Simplex (Pilcher).—This lesion is well shown in Plate V; it is confined to the trigone, and is seen most frequently in women. In the majority of cases there is no antecedent history of cystitis or pyelitis, but it is almost always due to extravesical pressure of some kind, usually an anteverted uterus, an enlarged cervix with a retroverted uterus, or impacted feces. It is the lesion found most frequently in the irritable bladder of women. Local applications of a 10 per cent. solution of silver nitrate will usually cure the disease, provided the primary cause is corrected.

Submucous Hemorrhages.—These may occur as the result of mechanical injury or as an expression of disease. Submucous hemorrhages are of frequent occurrence and appear as small, sharply defined, punctate, red or reddish-black spots, petechial, or covering large areas. A small

PLATE V



EDEMA TRIGONI SIMPLEX (Pilcher).

Showing a circumscribed edema of the trigone with considerable congestion. It is usually due to extra-vesical pressure of some kind, and is a lesion found most frequently in the irritable bladder.

In this plate is shown the right ureter opening corresponding to a kidney which has been removed. The opening is barely visible. The left ureter opening is practically normal and is functionating.

At the top of the picture is seen the vesical opening of a vesico-vaginal fistula of long standing, and is typical of this lesion when not associated with infection.

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hemorrhage beneath the mucous membrane, appearing as a bright red streak running across the bladder, has been noted in tuberculosis of the bladder and in intense cystitis. Small petechial points of hemorrhage may occur in the mucous membrane and infiltrate or bleed directly into the bladder. These are most frequently seen in acute cystitis. When a hemorrhagic infarct takes place, the entire area is infiltrated, edematous, and is raised up above the surface of the bladder. Lastly, a hematoma may form in the wall of the bladder, appearing as a tumor on its surface. In the first stages of an intense cystitis of the so-called hemorrhagic form, the entire surface of the bladder may be studded with hemorrhagic points.

Cyst Formations.—Simple vesicles of unknown origin are frequently seen on the trigone and on the base of the bladder. In disease they occur at any point and in connection with inflammatory conditions. Distended crypts and retention cysts are seen most frequently in the region of the vesical neck, but have no special pathologic significance.

CHANGES SEEN IN THE MUSCULAR WALLS OF THE BLADDER

Congenital and Acquired Diverticula.—Congenital defects in the muscular walls are not frequently found. The rare condition of ectopia vesicæ is not of interest to us here. Occasionally, we see multiple congenital diverticula appearing as dark cavernous openings in the otherwise intact wall of the bladder. These are distinguished from the acquired diverticula by the fact that their openings are smooth and not surrounded by a trabeculated bladder wall (Figs. 89, 90, 150, and 151). As an expression of disease, we see in many cases of urinary obstructions a marked development of the muscular bands traversing the bladder in every direction. This development takes place at the expense of the intermuscular tissue with a consequent weakening of the bladder wall resulting in the formation of pouches or diverticula of greater or less extent; when these become infected, they are extremely resistant to treatment. They frequently contain concretions and calculi.

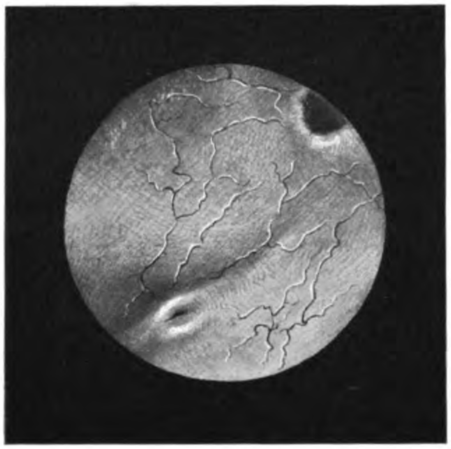


Fig. 150.—Congenital diverticulum with normal ureter opening.

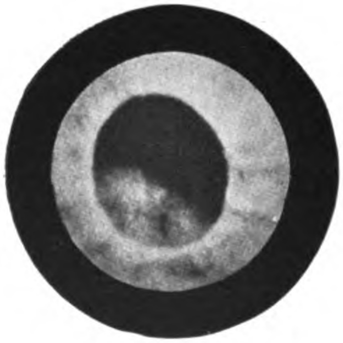


Fig. 151.—Congenital diverticulum (Nitze).

THE URETERAL OPENINGS

The Normal Orifice.—The point from which the ureteral mouth is viewed makes considerable difference in our estimation of its shape and formation, but, with practice, this source of error is eliminated. Figure 150 shows a perfectly normal ureter opening viewed at close range.

If the instrument is raised up and away from the opening, it appears much smaller. When looking down upon an opening, with the lens close to it, the opening is magnified and the lips appear slightly swollen. Inasmuch as this is the usual position for studying the ureter mouth, it is well to appreciate this fact. Again, the opening may be formed upon a distinct ridge, but when the lips show no definite changes the condition cannot be considered pathologic. The ridge is formed by the hypertrophied muscular walls of the ureter, and is usually exaggerated by the magnification of the lens (Plate III, opposite p. 124).

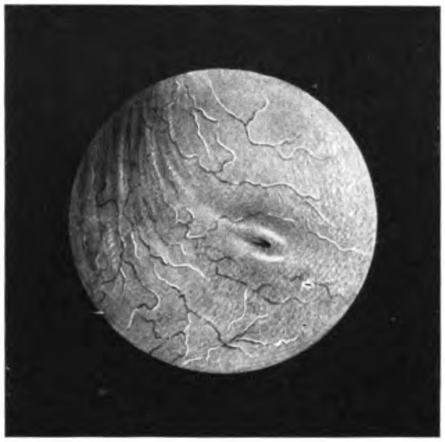


Fig. 152.—Cystoscopic picture showing a close view of a normal ureter orifice. The striations of the trigone are plainly seen, but are not always so marked.

Congenital Abnormalities.—There are certain congenital abnormalities in the position and morphology of the opening. Some cases have been observed in which the ureter has opened directly in the prostatic urethra, and others where the opening has occupied various positions in the bladder. There may be only one orifice present due to the absence of one kidney. There may also be two ureters coming from one kidney. As a rule, the two openings in this case are situated close together; a double ureter may, however, be joined before reaching the bladder and enter it by a single orifice. In several cases examined by myself there were three openings, all of which were normal in appearance. Usually, one ureter opening is found in its normal position on one side and a normal ureter opening in its normal position on the other side; the third opening is usually situated a few millimeters from one of the others. They functionate independently, contracting and dilating without reference to each other. A number of cases have been reported where four ureter openings were found in the same bladder. The importance of recognizing these openings arises from the fact that two of the openings may be normal and the third pathologic.

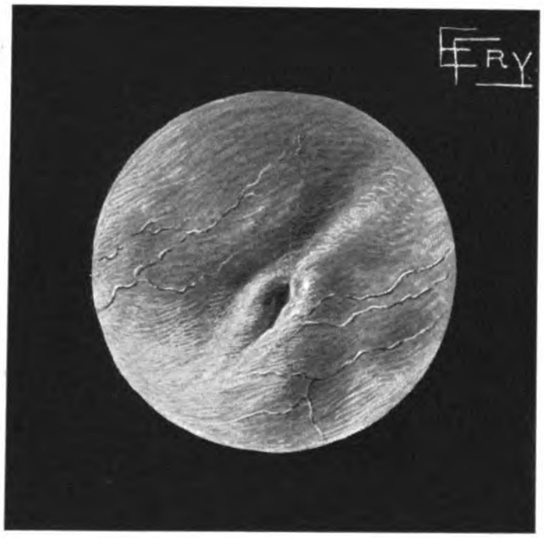


Fig. 153.—A close view through cystoscope of a dilated ureter opening with lax walls in case of prostatic obstruction.

A ureter opening may be present, but cannot be seen owing to swelling and inflammation or tubercular ulceration around its orifice. It may also be obscured by tumors or stones of large size. In such cases it is usually possible to demonstrate the opening by giving the patient an injection of methylene-blue or indigo-carmin and watching the point from which the discolored efflux appears. Also with the catheter cystoscope we are often able to locate an opening by passing a catheter into the tissue at the point where we know the opening should be.

Contractions of the Openings.—Normally, the opening contracts just as any orifice which is guarded by a sphincter. As the urine collects behind the contracting sphincter the tissue surrounding the opening shows a slight swelling, then the sphincter relaxes and a swirl of urine passes into the bladder. The number of these contractions varies so greatly in different individuals that no average will be given. Its action may be accentuated; that is, the force of the stream issuing from the opening may be increased when the kidney on that side is doing a greater amount of work, or when the muscular walls of the ureter are exerting their strength to rid the ureter of a foreign body. The number of contractions may be increased by hypersecretion, increased renal activity, or irritation of the kidney pelvis; they may be retarded by nervous influences, blocking of the ureter, or lack of secretions. They may be entirely absent after removal of the kidney or upon injury to the ureter. This is not always the case, however, because the ureter openings have been seen to contract after removal of the kidney, and in cases of uretero-vaginal fistulæ in which no urine enters the bladder from the kidney, but where the ureter has not been entirely severed.

Urinary Efflux.—This is usually coincident with the contractions of the ureter. If there is dilatation of the ureter opening, the flow may be continuous. Increased renal activity or irritation of the renal pelvis causes a more active efflux. It may be retarded and distorted by stricture or other ureteral obstruction; and it may be absent entirely in injury of the ureter, in complete obstruction of the ureter, or after removal of the kidney. Occasionally, complete anuria from purely reflex nervous causes is met with.

Character of the Urine.—Normal urine is clear and hardly perceptible as it escapes from the ureter. It may be cloudy when mixed with pus, phosphates, fat globules, or bacteria, or it may be displaced by solid plugs of pus. It may be bloody or discolored by drugs exhibited for that purpose. It is a mistake, however, to think that one can always tell by watching the ureter opening whether there is any pus or blood coming from that side, because such is not the case. As a rule, the pus or blood cells are relatively so few in number that when the efflux takes place and the urine escapes into the bladder, the color of the stream is so slightly changed that one cannot say absolutely whether it is discolored or not. When, however, there is a large amount of pus coming from the kidney, or an active hemorrhage takes place, it appears as a whitish or reddish cloud suddenly injected into a previously clear medium. One may sometimes be confused in watching a ureter opening, for as his attention is directed toward one opening, an efflux of bloody or cloudy urine may take place from the other side and pass in front of the lens of the cystoscope. This at first may deceive the observer, but a closer study of the ureter opening will correct the false impression.

Foreign Bodies in the Opening.—The ureter opening may be blocked by a stone which has descended from the kidney and is arrested at that point, or it may be occupied by a blood-clot or plugs of pus. In a case of the writer's, where there was an angiomatous growth at the lower end of the ureter opening, a portion of the mass appeared in the ureter opening resembling very closely a retained blood-clot. Further examination, however, demonstrated that it was an angiomatous disease of the ureter opening which was successfully removed at operation.

Changes in the Tissues Surrounding the Ureter Opening.—The mucosa surrounding the orifice is very frequently affected by inflammatory changes, especially if the corresponding kidney is extensively diseased. The usual phenomena of swelling, hyperemia, and ecchymosis are frequently seen. An ecchymosis is not characteristic of any form of disease, but is simply an expression of intense inflammation or superficial traumatism.

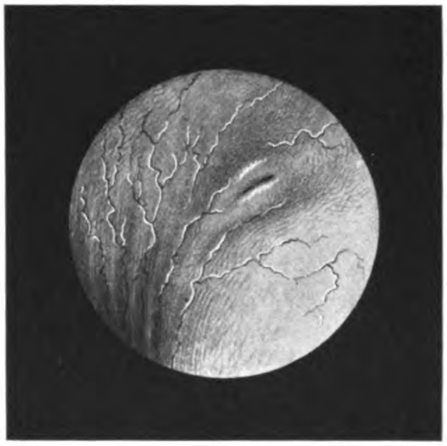


Fig. 154.—Cystoscopic picture showing a ureter opening in a case of parenchymatous nephritis. The lips of the opening are seen to be slightly swollen and edematous.

Prolapse of Mucous Membrane; Stricture; Laceration.—There may be a prolapse of the mucous membrane of the ureter resembling, on a smaller scale, the same condition as seen in prolapse of the mucous membrane of the rectum (Fig. 155). When the ureter opening is quiescent, the prolapsed tissue appears flat, reddish in color, and shows irregularly congested folds of ureteral mucosa. When the sphincter contracts, the center of the mass retracts and the entire mass around it swells. More of the mucosa then protrudes and later retracts. The entire mass has a distinctly cyanotic appearance.

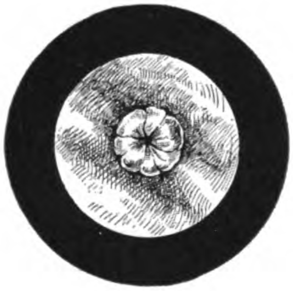


Fig. 155.—Cystoscopic picture of prolapse of the mucous membrane of the ureter opening. (Redrawn from Fenwick.)

When a stricture of the opening takes place, there may be considerable ballooning of the orifice, such as that seen in Figs. 156 and 159.

If a foreign body of considerable size has passed through the ureter opening, it may be lacerated. If there has been ulceration followed by healing, there will be some scarring and contraction of the opening.

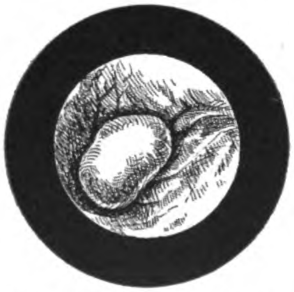


Fig. 156.—Cystoscopic picture showing a cyst of the lower end of the ureter. (Redrawn from Fenwick.)

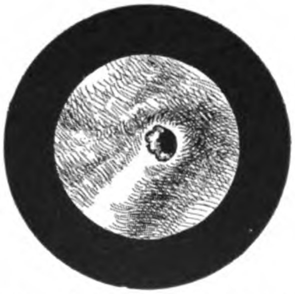


Fig. 157.—Cystoscopic picture showing ureter opening with an ulcerated edge. (Redrawn from Fenwick.)

Abnormalities in the Appearance of the Opening.—Hurry Fenwick, of London, has devoted an entire chapter to the description of the visual appearance of a diseased ureter opening as characteristic of certain renal affections.

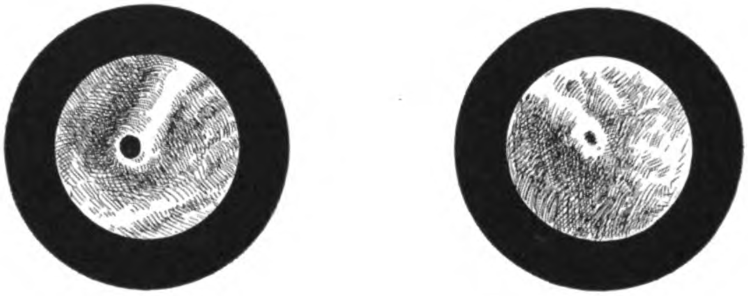


Fig. 158.—(*a*) Cystoscopic picture showing golf-hole ureter opening; (*b*) cystoscopic picture showing a pin-hole ureter opening. (Redrawn from Fenwick.)

In digesting these observations of his, we find many important suggestions; but I believe that the individual observer must formulate his own rules from personal experience, and should not be guided by written descriptions.

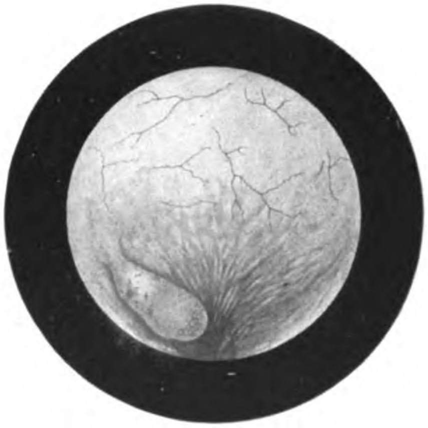


Fig. 159.—Cystoscopic picture of a cyst of the ureter opening (Fenwick).

In general, it may be stated that—

1. Edema and inflammation of a ureter opening is characteristic of a stone descending the ureter, tuberculosis of the kidney on that side, or advanced suppurative inflammation of the kidney.

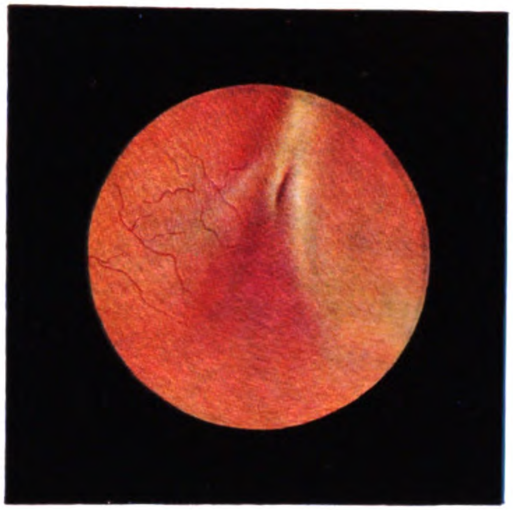
2. A golf-hole opening which is not inflamed is indicative of dilatation and atony of the ureter. If such an opening is inflamed and ulcerated, it is indicative of pyelonephritis (Fenwick) (Figs. 157 and 158).

3. A markedly vascular orifice is seen with dilatation of the renal pelvis, a recent profuse hemorrhage from the kidney, or a tumor of the kidney (Plate VI).

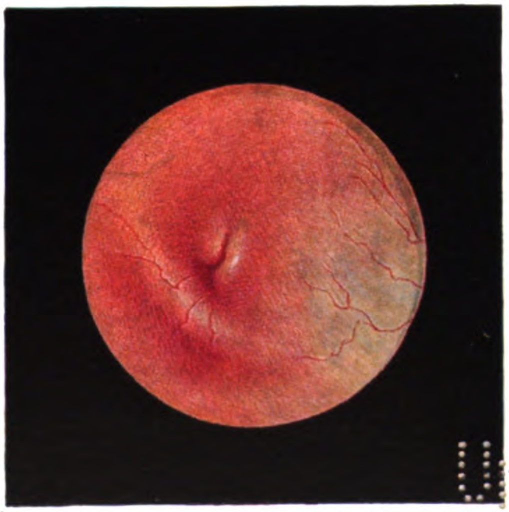
4. Ballooning of the lower end of the ureter, with the formation of a cyst in the bladder, is indicative of stricture of the opening (Figs. 156 and 159).

The writer believes that many mistakes will be made if one depends entirely upon the visual appearance of the ureter opening in the diagnosis of diseases of the kidneys. The employment of the ureter catheter is a more accurate means of diagnosis.

PLATE VI



Normal Ureter Opening and Ureteral Ridge.



Distorted Ureter Opening Corresponding to Renal Neoplasm of that Side.

Blood-vessels are seen emerging from the ureter opening.

CHAPTER II

INFLAMMATION OF THE BLADDER

INFLAMMATION of the bladder may occur alone or as a complication of other diseases. It may be acute, subacute, or chronic. It may be sharply localized, or involve the entire mucous membrane of the bladder, less frequently attacking the deeper structures. There may be multiple points or patches of inflammation; hemorrhages, erosions, tissue necrosis, ulceration, or gangrene may be associated with any type of the disease. The classic symptoms are *urgency of urination, pyuria, and pain.* The visual appearance of the inflamed area does not differ materially from that seen on other mucous membranes.

ACUTE CYSTITIS

Acute cystitis may be either localized, scattered, or general. When localized, it may be sharply circumscribed while the rest of the bladder is absolutely normal. When scattered, a larger area of the bladder may be involved with multiple localized foci of disease, the intervening tissue being apparently normal. In an acute infection, which is the most frequent type of inflammation, the entire surface of the bladder is usually involved. The inflammation begins, as a rule, in the region of the trigone, spreading out fan-shaped and involving the remaining surface of the bladder. When viewed through the cystoscope, the surface is intensely red, some areas, even in a general involvement, being more markedly affected than others. In the early stages the inflamed area is covered with a branching network of small vessels on a distinctly yellowish background. Later the redness is diffused over the entire area, and here and there dark red hemorrhagic spots are seen. This is most marked on the base of the bladder and in the neighborhood of the urethra. Swelling rapidly takes place and gives the surface of the bladder a wavy, uneven appearance. Later, the surface changes to a dull reddish color due to epithelial desquamation; the swelling may become so great as to resemble an edema bullosum. In the more intense forms of inflammation there will be more or less tissue destruction with resulting ulceration, or there may be a fibrinous exudate which combines with the mucopurulent secretions to form a grayish membrane over the surface. As a rule, this exudate becomes partially detached from the surface, causing a ragged, unhealthy appearance; or the pus and fibrinous matter may become rolled up in small masses and be deposited on the base of the bladder. When this

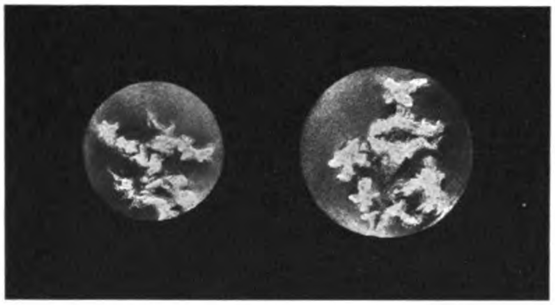


Fig. 160.—Cystoscopic picture showing muco-purulent masses lying on the base of the bladder.

stage of the process is reached, the base of the bladder appears grayish and the vertex more intensely red. All degrees and conditions of inflammation may exist, from a simple hyperemia and edema of the trigone, sharply localized, to an extensive ulcerative or gangrenous inflammation involving the entire surface and walls of the bladder.

When the deeper layers of the bladder wall become involved, the surface color becomes a dirty grayish-red, and the secretions, which are copious, appear as adherent flakes of muco-pus attached to the walls.

SUBACUTE CYSTITIS

After the acute inflammation of the bladder subsides, there often remain certain areas of the bladder which do not entirely regain their normal condition and give rise to persistent urgency of urination with only a moderate pyuria. This may be termed a subacute stage. Probably the most common lesion found in these cases is an edematous, swollen, hyperemic trigone, which has been termed trigonitis (Plate IV, opposite p. 196). There is, however, another picture which is frequently seen, occurring in addition to the trigonitis. The lesions are most numerous in the region of the vesical neck and consist of patches of inflammation of different degrees (Plate I). The patches are irregular in outline, generally circular, but they may be oval or drawn out in streaks. The center of the patch is an intense dull red in color surrounded by a dense zone of hyperemic vessels which seem to branch out from a central stem. Occasionally, the center shows an irregular ulceration, a yellowish-white surface surrounded by an area of intense injection. I have observed one case in which all of the patches showed ulcerative changes.

The trigone is edematous and hyperemic and the lips of the ureteral openings are swollen. A drawing made from a case of subacute patchy cystitis is shown in Plate I.

CHRONIC CYSTITIS

Chronic catarrhal inflammation of the bladder usually involves the base of the bladder and the region of the urethral opening. The blood-vessels are not so prominent, and are obscured by the infiltrated swollen mucous membrane. Here and there are dull reddened areas, poorly defined, surrounded by zones of grayish swollen tissues. Some portions of the bladder may be comparatively normal, but the base of the bladder is almost always involved, and the ureteral openings are generally swollen. All degrees of inflammation and ulceration may be seen. There are usually masses of secretion which collect in the bladder or appear attached to the walls, giving a dirty, uneven appearance to the surface. Occasionally, when the irritation is long continued, the swelling may assume a papillary appearance resembling markedly an infiltrating carcinoma. In other cases distinct granulations are seen.

Chronic Cystitis Associated with Obstruction.—Here all the changes incident to chronic catarrhal inflammation are seen. If due to a hypertrophied prostate, the irregular growths surrounding the urethral opening are observed. The sharply defined sphincter is lacking, and the trigone is flattened out and appears as a thickened parchment-like triangular strip of tissue, whose base is formed by the thickened, irregular, cord-like interureteric band. The delicate network of vessels cannot be seen, and only occasionally are dilated veins or thickened arterioles visible.

The ureter openings are distorted and difficult to find, owing to the presence of innumerable trabeculæ and false diverticula which abound in this region. The muscular walls of the bladder, as a rule, are enormously developed, traversing the sides of the bladder in every direction, forming intricate interlacing bundles of tissue which stand out prominently, resembling the columnæ carneæ within the ventricles of the heart (Figs. 88 and 147). Between the bundles are pits or depressions which vary in depth, presenting a black cavernous appearance. These often develop to such an extent as to form deep sac-like diverticula. Everywhere the mucous membrane has lost its lustre and is of a grayish or dull slate color, with here and there areas of necrosis, erosion, or even ulceration. In many cases the vertex of the bladder does not share to an equal degree in these destructive processes, and the mucous membrane of that portion of the bladder may appear fairly normal. If the disease is far advanced or active, shreds of muco-pus, plaques of lymph, and strips of tissue encrusted with phosphatic salts may be seen. Smaller or larger calculi may be found either lying free on the floor of the bladder or protruding from the openings of the diverticula. Occasionally the openings of the diverticula will be found encrusted with phosphatic deposits, the first step in the formation of calculi. All stages of inflammation may be seen, including the formation of tubercles, vesicles, and distended mucous crypts.

CHRONIC TRIGONITIS (CYSTITIS COLLI VESICÆ)

Chronic trigonitis is simply a form of chronic cystitis involving the neck of the bladder in which there is con siderable edema of the trigone. It is characterized by swelling and edema of the mucous membrane, with the formation of small vesicles, and occasionally tubercles, with a marked increase in the number of blood-vessels, giving to the mucous membrane a bright red appearance. The remaining portions of the bladder are practically normal, the process being sharply localized and resulting in a chronic thickening of the trigone. The condition is described by many writers as chronic trigonitis, and is frequently met with in cystoscopic work. It gives rise to frequent and painful urination. Many cases of chronic cystitis resolve themselves into a chronic trigonitis which leaves the patient with an irritable bladder for some time.

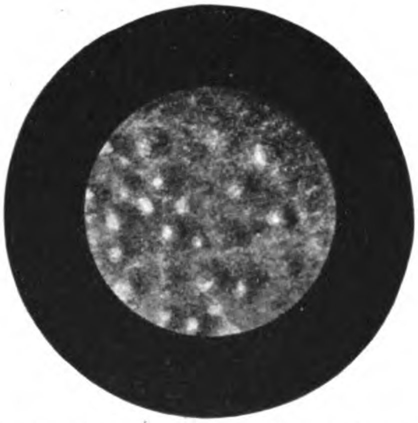


Fig. 161.—Cystitis granularis; cystoscopic picture showing condition of the bladder wall (Knorr).

CYSTITIS FOLLICULARIS ET GRANULARIS

Knorr describes a form of cystitis in which there is a sub-epithelial, round-celled infiltration with the formation of small nodules filled with lymphocytes and lymph. In appearance they resemble very closely tubercular nodes and are seen most frequently in chronic cystitis. The mucous membrane surrounding the nodules is of a deep red color, but occasionally this change is not present (Fig. 161).

CYSTITIS CYSTICA GLANDULARIS (Knorr)

This form of cystitis is designated by Rokitansky and Klebs as a herpes vesicæ urinariæ. It is described as a chronic inflammatory process which occurs in the bladder, characterized by a proliferative epithelial change. The affected area appears to be covered with small cysts, yellowish and gray in color, which contain a colloid material. They are seen most frequently in chronic trigonitis, as an expression of long-continued inflammation; still they may occur in the normal mucous membrane.

CYSTITIS MEMBRANOSA

In this form of cystitis there is a formation of a false membrane on the surface of the inflamed mucosa. It is of frequent occurrence and is of no special pathologic significance. When this membrane comes away, it leaves a raw, bleeding surface.

CYSTITIS HÆMORRHAGICA

This form of inflammation hardly needs a separate description, as it occurs in the majority of the severe cases of inflammation. Many of the severe cases of cystitis show numerous hemorrhagic areas scattered over the surface of the mucous membrane. They vary from a few hemorrhagic spots to a condition where the entire lining of the bladder is dotted with petechial hemorrhages. Between these areas the mucous membrane is seen to be acutely inflamed.

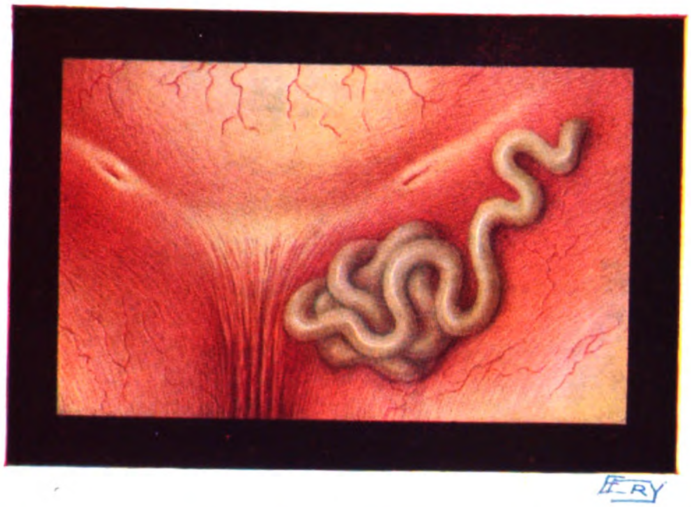
CYSTITIS GONORRHOICA

This form of inflammation is usually confined to the neck of the bladder and is very intense in its onset. The tissue is swollen and dark red in color, with marked edema. There are generally small areas of hemorrhagic infiltration with slight erosions. The remaining portions of the bladder are either normal or slightly hyperemic. Occasionally the inflammation spreads to the entire surface of the bladder. Cystoscopic examination in this class of cases is, as a rule, contraindicated, so that we do not see many in the earlier stages, and most of our observations are confined to the more chronic cases. In the chronic forms the disease is apt to be diffuse, attacking certain areas of the bladder, while the intervening tissues are normal. There are numerous areas of ecchymosis. The picture is not sufficiently characteristic to allow one to make a differential diagnosis from the cystoscopic findings alone.

ŒDEMA TRIGONI MEMBRANOSUM (Pilcher)

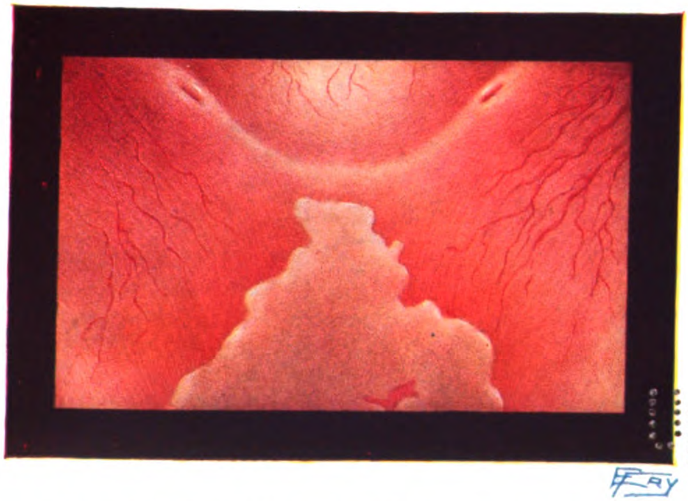
Plate IV, opposite p. 196, shows a somewhat exaggerated picture of this lesion. It is the result or aftermath of a severe cystitis. The trigone is congested, inflamed, lumpy, and is covered by a tenacious, grayish-white membrane which peels off very easily, leaving a somewhat raw surface which bleeds easily. Hematuria with marked irritability of the bladder, with pain especially at the close of urination, is characteristic of this disease.

PLATE VII



Fistula of the Bladder Communicating with a Chronic Psoas Abscess.

In this case there was no cystitis present, although a very marked pyuria existed. The pus was thick and was expressed into the bladder through a fistula near the left ureter opening, as shown in the picture. Drainage of the abscess cavity cured the fistula.



Edema Trigoni Pseudo-membranosum (Pilcher).

A condition very frequently met with in women as a result of continued pressure on the trigone. The entire urethra and vesical neck are swollen and bleed very easily. The urine is clear. The symptoms are frequent urination and burning with and following urination. It is the lesion most commonly found in women having frequent urination without previous history of bladder trouble.

CHAPTER III

TUBERCULOSIS OF THE BLADDER

THE great majority of the cases of tubercular cystitis, probably 95 per cent., are secondary to tuberculosis of the kidney. The renal symptoms, however, are very slow in developing, and attention is first called to the disease when a patient is presented suffering from dysuria, or a persistent pyuria, with frequent urination both day and night. A further search into the history does not develop any known starting-point for the infection.

The history of the case and the appearance of the urine are especially helpful in making a diagnosis, while finding pus and tubercle bacilli in the urine, and a positive guinea-pig test are pathognomonic. The urine is of low specific gravity, acid in reaction, and looks like weak lemonade. (Plate X, p. 373.) The sediment is usually large in amount and sticks to the side of the glass container. Generally there are numerous red blood-cells present. The only constant symptoms are pus in the urine, an acid urine, and tubercle bacilli, usually accompanied by marked frequency of urination. These symptoms are progressive and long continued, and do not yield to the ordinary methods of treatment for cystitis. The bladder is especially intolerant of silver nitrate.

It is difficult for purposes of description to draw a line between the changes which take place around a ureter opening corresponding to a tubercular kidney and that which we may more correctly consider a tubercular cystitis, for it is exceptional that the latter is not preceded by the former. The lesions involving the ureter opening will be taken up under renal tuberculosis.

According to Walker, Motz, and Halle, the pathologic changes which take place in tuberculosis of the bladder are divided into four stages: first, the period of invasion and formation of tubercles; second, the period of superficial ulceration; third, the period of deep infiltration; and fourth, the period of wide-spread destruction. From personal observations the writer is led to believe that in the majority of cases the first change seen is hyperemia confined to the base and trigone of the bladder; that the changes which take place in the mucous membrane are almost identical with the process of inflammation caused by other bacteria, namely, hyperemia, exudation, round-celled infiltration, and ulceration; that the ulceration may be caused by the coalescence and breaking down of tubercles, but in the majority of cases this is not so.

Cystoscopy.—This is difficult in most cases, but may be practised without harm to the patient. The two great sources of difficulty are the marked intolerance of the bladder to a foreign medium and the constant clouding of the same by pus and blood. The methods of overcoming these have already been referred to. Many cases cannot be examined without a general anesthetic, and one should not hesitate to use it when necessary. While it is doubtless true that the examination is less painful when using the patient's urine for the medium (Keller), this, however, is not possible in the more advanced cases.

The appearance of the bladder in tubercular cystitis does not differ much from that of many other forms of severe cystitis, except in the more frequent occurrence of tubercular nodules and multiple deep ulcerations, and the fact that it occurs usually in the neighborhood of an ureter opening and does not tend to spread widely and involve large areas of the bladder. It is rare that we see the early stage of so-called miliary tubercles in the bladder. However, it is common to find nodular formations, granulation-like tissue, and vesicles filled with grumous material, giving a picture which closely resembles the miliary tubercles.

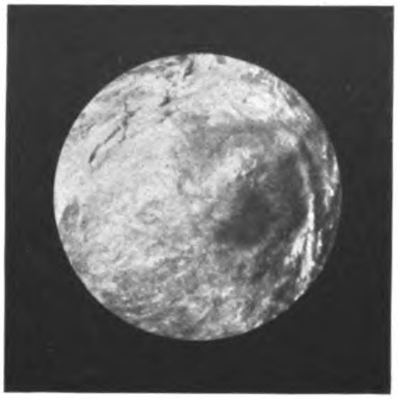


Fig. 162.—Cystoscopic picture showing an area of tubercular disease without ulceration. To the unpracticed eye the condition might easily be mistaken for an ulcer and be treated as such, which would be unfortunate, inasmuch as the mucous membrane is not broken; but there is a deep zone of round-celled infiltrations.

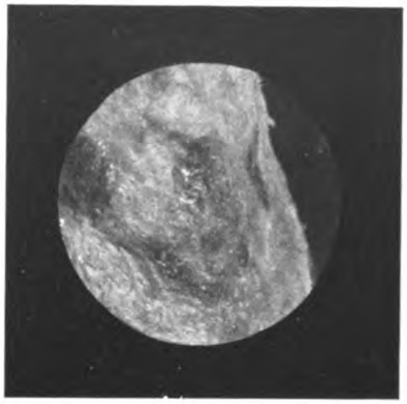


Fig. 163.—Cystoscopic picture showing areas of tuberculosis of the fundus of the bladder. Here and there are seen small tubercles.

Miliary Tubercles.—These usually occur in groups situated around or near a ureter opening, or on the trigone or base of the bladder. In their earlier stage, they appear as minute, rounded, pearl-like nodules scattered over the mucous membrane. Gradually they increase in size, becoming more elevated, and change to a grayish, translucent color with a yellowish center, finally becoming opaque. The surrounding mucous membrane is moderately injected. They may finally coalesce and form a tubercular nodule, and later break down leaving an ulcerated surface. They are not easily confused with any other vesical lesion.

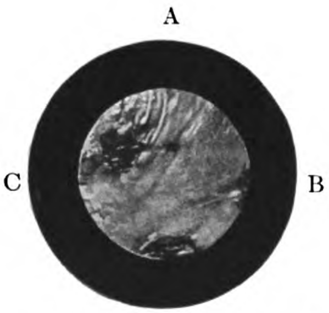


Fig. 164.—Cystoscopic picture showing various stages of tubercular ulcers of the bladder. At "C" is shown a ragged ulcer with the mucous membrane entirely destroyed. At "A" the healed ulcer, the result of local or topical applications. At "B" is seen a cicatrix leading to an unhealed ulcer.

Tubercular Nodules.—These are occasionally met with. In one case of the writer's it was seen on the vertex or anterior wall of the bladder, without any other inflammatory changes in the mucous membrane of the bladder. The diseased area was about the size of a silver half-dollar, elevated, irregular in contour, nodular, and its surface showed hemorrhagic areas, with minute erosions.

Tubercular Ulcers.—These are almost always seen at some stage of the disease. They are usually multiple, but occasionally one large ulceration is seen. They are most frequently found near a ureter mouth and just behind the interureteric band. They are irregular in outline, with a necrotic, unhealthy base, raised and undermined edges, and surrounded by a dense zone of infiltrated tissue.

As a rule, they do not show deposits of adherent phosphatic crusts. We sometimes see areas of healed tubercular ulcerations showing cicatricial tissue (Fig. 164).

General Tubercular Cystitis.—As a rule, a tubercular cystitis does not become generalized unless there is a secondary infection, and this obscures the real extent and character of the tubercular involvement. All grades, degrees, and stages of inflammation may be seen in these cases.

The stages of ulceration, deep infiltration, and destruction are frequently seen in advanced cases.

Differential Diagnosis.—In the majority of cases the establishment of an exact diagnosis is difficult. Reviewing the cases which have been examined by the writer, they may be separated into three classes, each class presenting symptoms easily confused with those due to other causes.

Class 1.—Those cases in which a *subacute inflammation of the bladder occurs in a young adult* without any previous history of infection or injury of the genito-urinary tract, and in which proper and long-continued treatment of the cystitis fails to bring about a cure. The same clinical symptoms, which are not severe, are sometimes met with in cases of a foreign body in the bladder, solitary ulcer of the bladder, and new-growth of the bladder. To differentiate between these four conditions, the cystoscope is absolutely necessary, since the relative uncertainty of finding tubercle bacilli in the urine makes an examination of the urine alone not entirely dependable. Von Pirquet's inoculation test has not been employed by me. The use of tuberculin injections will give a positive reaction. By far the simplest method of diagnosis is the employment of the cystoscope, which will readily afford means of differentiating between the lesions mentioned.

Class 2.—Those cases in which an *acute and painful cystitis is present without known cause.* The symptoms are severe and continuous, and clinically cannot be differentiated from an acute cystitis due to other causes. Such manifestations are usually due to a wide-spread tuberculous cystitis, or may occur in an advanced stage complicating a renal tuberculosis. A differential diagnosis under such conditions is always difficult because instrumental examination, excepting in great extremity, is contraindicated. We must depend largely on a careful microscopic and bacteriologic examination of the urine for our diagnosis. Later, after the acuteness of the disorder has abated, the cystoscope may be used and the typical picture of a tuberculous cystitis, with tubercles and areas of hyperemia and ulceration, may be found. This is not always the case, however, and unless tubercle bacilli can be demonstrated in the urine, a positive diagnosis is frequently impossible.

Class 3.—This comprises a few *cases in which hematuria occurs,* with or without other vesical symptoms. The writer has seen only one such case in which the hemorrhage came from the bladder. It may be confused with hemorrhage from the kidney or hemorrhage from an ulcer or new-growth in the bladder. In differentiating between these various conditions, the cystoscope is indispensable. The kidney may easily be excluded. It is more difficult, however, to distinguish between tubercular and non-tubercular ulcers. The tubercular ulcer is, as a rule, more irregular in outline, with a necrotic, unhealthy base and undermined edges.

Occasionally, a tubercular nodule is met with which gives rise to hematuria. New-growths, if of small size, can only be excluded by cystoscopic exploration. Demonstrating the tubercle bacilli in the urine is the best means of establishing the character of a lesion after its location has been determined.

Indications for Treatment.—The occurrence of a tubercular cystitis in the neighborhood of a ureter opening would strongly suggest tuberculosis of the corresponding kidney. Under such circumstances, no treatment should be undertaken until the entire extent of the infection has been determined. If unilateral renal tuberculosis exists, removal of the kidney is indicated. When this has been accomplished, the bladder, as a rule, will heal spontaneously, even when multiple ulcerations are present. With bilateral renal involvement, local applications and the injection of healing lotions are indicated, and considerable good may be looked for, but a cure is very exceptional.

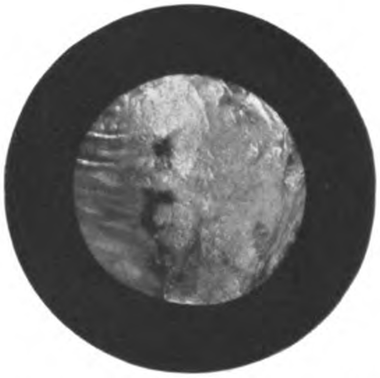


Fig. 165.—Cystoscopic picture showing healed tubercular ulcers of the bladder. In this case the ulcerations were curetted and then touched with a strong silver nitrate solution.

If a single primary tubercular area is found in the bladder, attempts should first be made to destroy the diseased area through the cystoscope, using the actual cautery, the electric cautery, local applications of strong silver nitrate or other caustic. If multiple small ulcers are present, they may be curetted and cauterized. If a general cystitis is present, instillations of iodoform emulsion or solutions of carbolic acid or corrosive sublimate should be used. Irrigating with solutions of silver nitrate is extremely painful. Where a large area of bladder tissue is ulcerated and destroyed, excision of the entire thickness of the bladder wall may be done through a suprapubic opening. One should hesitate to open the bladder in a case of tubercular involvement because of the great danger of secondary infection.

Note.—Cabot thinks that the statement that the bladder will heal spontaneously after removal of the diseased kidney is an unduly favorable one. He suggests the routine use of sandal oil and tuberculin, with careful hygiene in the after-treatment.

CHAPTER IV

ULCER OF THE BLADDER

Appearance.—In using the cystoscope for the diagnosis of ulcer of the bladder, it must be remembered that the size, shape, and depth of an ulcer depend on whether it is stretched or flaccid, and this must again depend on the amount of water medium used at the examination and the degree of elevation of the pelvis. An ulcer viewed in a four-ounce medium is probably one-third smaller than that viewed in an eight-ounce medium. Moreover, its appearance changes. Fenwick,* who was the first to make these observations, states further: "Let any cystoscopist examine an ulcer in a fully distended bladder by means of an irrigating cystoscope, it will appear as an erosion of a flat surface. Let him now gradually draw off water from the bladder, and he cannot fail to notice this shallow ulcer change to a projecting rolled Hunterian-chancre-like sore. Two results ensue if water is forced in beyond the distention limit acquired by any particular ulcerated bladder. At first the edge of the ulceration tears and a sharp hemorrhage occurs, so sharp as to render cystoscopy futile. If the distention is persisted in, the muscular layers split, subperitoneally, and extravasation ensues."

We have already considered ulceration in connection with severe cystitis, as well as tubercular ulceration. There are, however, other forms of ulceration which occur in the bladder, such as traumatic ulcers, typhoid ulcers, the solitary ulcer of Fenwick, and malignant ulceration.

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* Clinical Cystoscopy.

Traumatic Ulceration.—Traumatic ulceration occurs as a result of injury, mechanical, chemical, or thermic. The appearance of the ulcer varies with the extent of the lesion and does not differ in any way from a similar lesion on other mucous membranes. They are irregular in outline, generally shallow, with a smooth, yellowish-white base and slightly raised edges. They are always surrounded by an area of hyperemia.

Typhoid Ulceration.—Typhoid ulcers are occasionally met with in the bladder. In a recent case the writer found three such ulcers of small size on the posterior wall of the bladder. They resembled typhoid ulcers seen in the intestine.

Solitary Ulcers.—Fenwick, who was the first to describe this form of ulceration, acknowledges that it is extremely difficult to discriminate on visual grounds between a solitary simple chronic ulcer and a chronic tubercular ulcer. His observations are worthy of attention, and his description of this form of disease will be given.

Solitary simple ulcer of the bladder resembles very markedly solitary ulcer of the stomach. They both occur on the posterior wall of the viscus, near an orifice—the vesical ulcer on the posterior wall, near the ureteric orifice; the gastric ulcer near the pylorus. Both chronic forms are usually solitary, both may originate in lymphoid nodules. In both the chief symptom is profuse hemorrhage. Both tend to scar and their cicatrices to warp the normal contour of the viscus. The bladder ulcer is probably, like the duodenal ulcer, more common in men; the gastric, in women. It must be distinctly understood that the solitary simple vesical ulcer will be rarely encountered. Most of the patients are young men about the age of twenty. The ulcer is usually single, about the size of a silver quarter, situated usually to the inner side of the ureteric orifice, but not affecting the trigone. Its edges are raised and thickened, and its base is uneven and sloughy, but not deep. The surface of the ulcer is often obscured by a deposit of phosphate of lime. Fenwick believes that these ulcers are liable to undergo tubercular changes, but if they resemble gastric ulcer, we would expect carcinomatous degeneration. The only way of definitely determining the character of the ulcer is by finding tubercle bacilli in the urine or by a guinea-pig test.

The symptoms of the primary stages of solitary ulcer are frequency of urination, blood in the urine, and pain. Later, the symptoms of a chronic cystitis are present, to be followed by the distressing frequency of an irritable, contracted bladder.

Carcinomatous Ulceration.—Clinically carcinomatous ulceration is characterized by frequency of urination and by pain referred either to the suprapubic region or to the region of the external meatus. Hematuria is not an early symptom, but develops later, and it is frequently complicated by cystitis. There is no way of making an exact diagnosis of this condition except by visual inspection.

The Superficial Type.—Malignant ulceration in its simplest form is seen in cases of epithelioma, which is a rare disease in the bladder. According to Fenwick, the growth resembles the epitheliomatous ulcer of the skin, having an uneven, nodulated, sloughy base, and up-raised, indurated edges of irregular outline. Its most frequent site is the trigone and base of the bladder. It may begin as a rounded nodule or an indurated plaque in the mucous membrane, breaking down and forming an ulcer. It tends to spread superficially at first, involving larger areas, and finally infiltrating the deeper tissues in a general carcinomatous process.

The Infiltrating Type.—Here an indurated nodule appears and rapidly ulcerates, infiltrating the surrounding tissues. The base of the ulcer is infiltrated and nodular, and the edges are irregular, dense, and elevated. The entire diseased area is raised up above the surrounding mucous membrane. In a case of the writer's the epitheliomatous growth was situated on the anterior wall of the bladder, and was covered with papillary outgrowths which were degenerated and covered with muco-purulent shreds. In this case there had never been any hematuria, but small muco-purulent shreds were evacuated, and attached to each were minute specks of coagulated blood. The symptoms were those of frequent painful urination, with constant pain referred to the suprapubic region.

The Fungating Type.—All forms of fungating carcinoma of the bladder sooner or later show superficial ulceration. Such surfaces are rich in blood-vessels and severe hemorrhage is a frequent symptom. They show the same characteristics as superficial ulceration anywhere in the body.

CHAPTER V

TUMORS OF THE BLADDER

Cystoscopic Diagnosis.—Tumors of the bladder are occasionally encountered in the course of systematic bladder examination. They may be present without giving rise to any symptoms, or they may give rise to most alarming and distinct disturbances of the bladder. The older methods of diagnosis have always been uncertain, and while it is true that a tumor of the bladder can frequently be diagnosed from the clinical symptoms, still the cystoscope offers a new method of examination whereby we can determine with absolute certainty the presence or the absence of a tumor, its situation, and its character. Many patients suffering from hematuria have been subjected to suprapubic cystotomy on the supposition that the source of the hematuria was a tumor of the bladder, when, in fact, the hemorrhage was coming from the kidney. It is not always possible, however, to make a complete cystoscopic examination in the presence of tumors which give rise to extensive hematuria, but this difficulty may often be overcome by patience and gentleness. The greatest value in the use of the cystoscope lies in determining the number, location, extent, and character of the growths. When these points have been determined, they should be carefully charted and an estimation of the relative size and position of each tumor mass which is seen should be noted. The four points above mentioned having been determined, the character of the operation can be carefully planned beforehand and intravesical, extraperitoneal, or intraperitoneal operation selected.

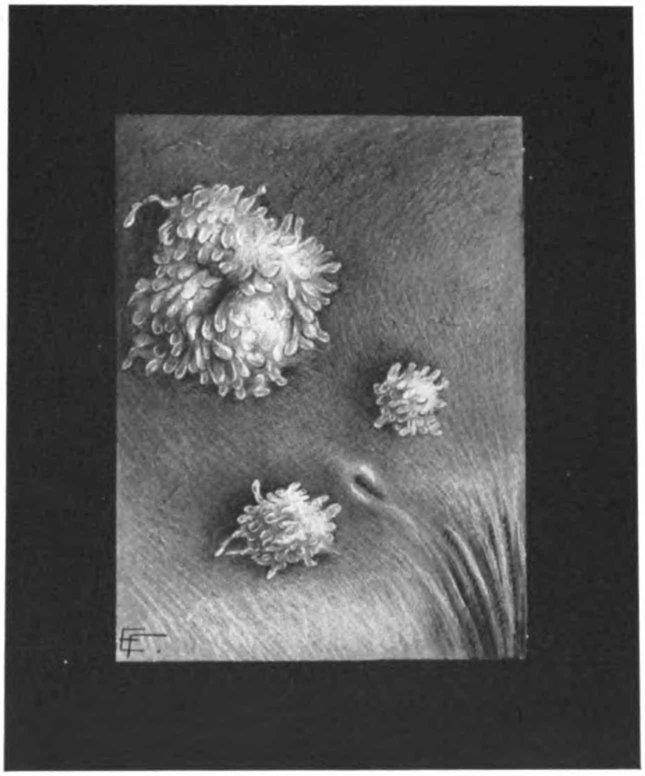


Fig. 166.—Cystoscopic picture showing multiple papillomata, the larger one of which has undergone carcinomatous degeneration. This fact, however, was not determined until a section was examined under the microscope. The symptoms in this case were sudden symptomless hematuria in a young woman. Later pain in the region of the right kidney, with swelling of that organ, was complained of. Cystoscopic examination revealed the above picture. Suprapubic cystotomy was performed, and the tumors were removed with thorough cauterization of the base. The patient has remained well for over fourteen months.

Technic of the Examination.—The preliminary preparation of the patient is of importance, for in almost all of these cases there is associated more or less hemorrhage which is apt to be increased by the manipulations. The patient should have the lower bowel emptied; should be placed in bed for at least twenty-four hours before examination, and should be given a course of drug treatment to render the urine as antiseptic as possible, since one of the great dangers to be feared as a result of such an examination is the production of a cystitis. In preparing the bladder for examination, repeated irrigation and unnecessary movements of the instrument should be avoided. As a rule, a single irrigation, in a bladder in which the urine is obscured by blood, is sufficient to clear the medium for examination. In case the bleeding still continues, air or oxygen may be used as a distending medium.

Difficulties Encountered.—Hemorrhage is by far the most usual difficulty we have to overcome. It may originate either from overdistention of the bladder and tearing of the tumor, or from direct injury by impingement of the instrument used. This can be overcome by care. The second difficulty is the lack of distensibility due either to infiltration of the bladder wall by the growth, or to the size of the growth filling the lumen of the bladder. In one case of my own the growth was so large that it was impossible to distend the bladder sufficiently to allow of a cystoscopic examination. If a cauliflower-like growth fills the bladder, the lamp of the cystoscope may be buried within it, or the lamp be on one side of the growth and the prism on the other. Another complication is the frequent occurrence of cystitis in these cases, making the bladder so irritable that sufficient medium cannot be introduced.

These difficulties are, however, the exception, and in all the cases which have been presented to me for examination I have been able to obtain a fairly clear view of the tumor mass, with the exception of one case in which the tumor was so large that it bulged into the vagina and further attempts were not made.

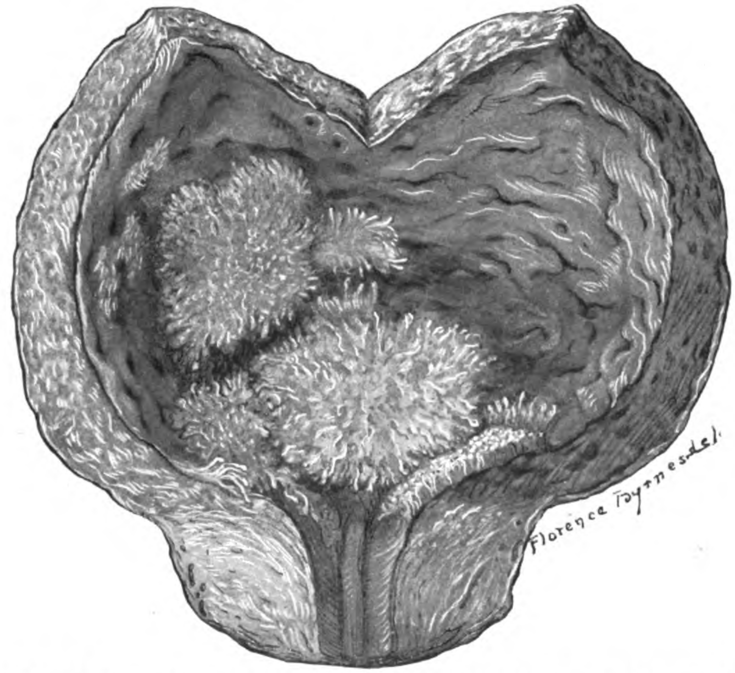


Fig. 167.—Malignant growths on the bladder (Watson and Cunningham).

Character of Growths Found in the Bladder.—From the standpoint of the cystoscopist, bladder tumors may be divided into several classes.

The Simple Fibro-papilloma.—This resembles a small pedunculated fibroid of the uterus, varying in size from a pea to a growth as large as an egg. It is usually single, nodular, and distinctly benign in character, seldom causing any symptoms, and is usually discovered accidentally in the course of other examinations. It hangs by a stalk into the lumen of the bladder and moves about with every wave of the fluid contained.

Villous Papilloma of the Bladder.—Villous papilloma is morphologically the commonest form of bladder tumor. It is at first benign in character, but almost invariably assumes, at some period of its existence, malignancy. It presents one of the most beautiful pictures seen in the bladder. It is generally single at first and situated near one of the ureter openings. Later there is a tendency to multiplicity, with the formation of other papillomatous growths scattered over the posterior wall of the bladder, trigone, and the region of the ureter openings. It may arise directly from the mucosa and is usually attached to the bladder wall by a pedicle, but its base may be sessile. Sometimes the growth possesses a pedicle which is difficult to see owing to the exuberance of the papillomatous tufts around the base of the tumor. When attached by a pedicle, the tumor

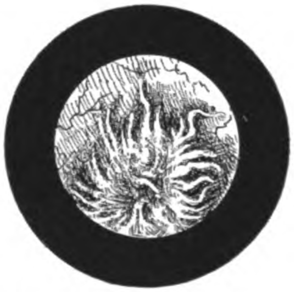


Fig. 168.—Cystoscopic picture showing a benign villous papilloma.

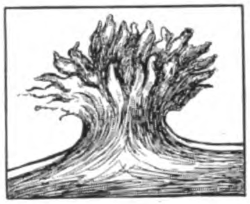


Fig. 169.—Cross-section of a non-malignant growth of the bladder, showing its relation to the underlying structures (after Fenwick).

frequently changes its position and it is difficult to tell exactly to what point it is attached. These tumors vary greatly in appearance. One type of the tumor appears to be made up entirely of long streamers or fimbriæ of tissue, varying from a quarter of an inch to an inch and a half in length, floating in the fluid medium, resembling so many blades of withered grass gathered into a bundle, or, as many have described it, as a bunch of sea-weed. These delicate tendrils move with every swirl of urine excreted from the ureters. Their color is either a glistening white or a tawny yellow. Many different formations and shapes are assumed by these papillomatous streamers, varying from that just described to a closely matted mass of tissue which looks like a collection of brownish moss; the color of this may also be a glistening white and resembles somewhat the appearance of sprue in the pharynx. These growths are extremely characteristic and are very luxuriant. They are single at first, but almost always develop secondary foci. Again, this papillomatous tumor

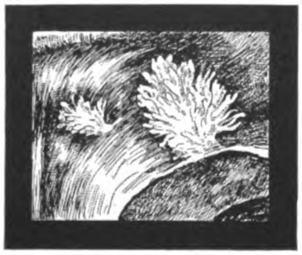


Fig. 170.—Section showing early stages of multiple villous growths of the bladder.

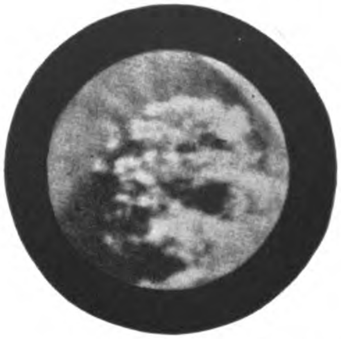


Fig. 171.—Cystoscopic picture showing a pedunculated villous papilloma (Nitze).

may be packed together so closely that it appears like a cauliflower growth or a flattened tumor on the bladder surface. Such tumors have a reddish color and may also show tufted areas. The papilloma itself may be benign, but the base often shows malignancy.

Papillary Carcinoma.—This cannot always be differentiated from the villous papilloma without resort to the microscope. It appears as a papillomatous growth. suspended by a pedicle which is closely bound down to the infiltrated bladder wall. However, the pedicle or base of the tumor may be obscured by inflammatory deposits and an exact diagnosis is not possible.

Infiltrating Carcinoma of the Bladder.—This form of malignant disease is frequently seen either as a primary cauliflower-like growth, an epitheliomatous ulcer, as already described on page 234, or as an infiltrating growth without distinct tumor formation. This last is often seen when carcinoma of the uterus or prostate extends to the bladder. The surface presents a nodular edematous appearance without any change in the overlying mucous membrane; this is almost always true of cancer of the prostate. The terminal stages show a massive, irregular, carcinomatous growth which affects more frequently the posterior surface of the bladder and spreads out over the mucous membrane. Any form of carcinoma may show growths of papillomatous villi of varying degrees or appear nodular and ulcerated.

Fibro-carcinoma and colloid carcinoma are occasionally met with. Fibromata are rare, but are sometimes seen as hard pedunculated tumors, covered by normal mucosa. They resemble the form of tumor seen in the uterus.

Sarcoma.—Sarcoma of the bladder occurs most frequently in comparatively young persons, but it has been observed in adults between forty and sixty years of age. It does not vary in its characteristics from sarcoma of other portions of the body, presenting a smooth, rounded tumefaction covered with a glistening whitish mucous membrane, through which run enlarged blood-vessels. The infiltrating form also occurs. It is of rare occurrence.

There are a number of other forms of tumor growth in the bladder, such as adenoma, myxoma, myoma, etc., but they possess no characteristics which make a diagnosis by means of the cystoscope possible.

Diagnosis of Tumor of the Bladder.—The points which the cystoscopist has to decide are—

1. Does a tumor of the bladder exist?
2. Where is it situated?
3. Is it single or multiple?
4. What are its characteristics—benign or malignant?
5. What effect has it upon the surrounding tissue and ureter openings?
6. Does it infiltrate the bladder walls?
7. What form of operation should be adopted to remove it?

The history and symptoms of a tumor of the bladder are seldom sufficiently characteristic to enable one to make an exact diagnosis. In the early stages of tumor formation, unless pressure exists, there are usually no symptoms. As a rule, the first sign of trouble is a symptomless hematuria brought on by exercise or overexertion of some kind. The attacks of hematuria are intermittent, increasing in frequency as the tumor grows or becomes more irritable. The later stages of growth are almost always complicated by cystitis with its train of symptoms. In some cases impediment of urination and hematuria are the only symptoms, while in others they resemble those of stone in the bladder. The cystoscopist seldom fails to demonstrate the presence or absence of a tumor. It is situated, in the majority of the cases, in the neighborhood of one of the ureter openings, but may occupy any site in the bladder.

Simple fibro-papillomata and some villous papillomata occur as solitary tumors, but either of them may be multiple.

A simple fibro-papilloma, as described above, or a single well-developed villous papilloma suspended on a pedicle, showing no pathologic change in the mucous membrane of the bladder surrounding the base of the tumor and with no evidence of infiltration of the bladder wall, discovered in the bladder of a patient under forty years of age, may safely be diagnosed as a benign growth. All other tumors of the bladder, in the experience of the writer, are either malignant or have a tendency to recurrence after removal, with the later development of malignant characteristics.

The Effect upon the Surrounding Tissues.—The situation of the growth near a ureter opening almost always causes some change on that side, usually congestion of the ureter opening and puckering of the tissues, or even a sufficient distortion of the tissue surrounding a ureter to cause obstructive symptoms in the kidney on that side. In malignant cases there is usually an increase in the vascularity of the surrounding tissue, sometimes with edema. Cystitis often occurs. Implantation growths are often seen, as if a piece of the tumor were grafted upon the mucous membrane coming in contact with the tumor. This is probably the reason for multiplicity in the papillomatous growths.

Indications for Treatment.—We believe that the removal of pedunculated growths by the use of various cutting instruments used through the cystoscope is dangerous and unnecessary. If the case is malignant, it opens up avenues for reinfection. If it is not malignant, it can be almost surely destroyed by the high frequency spark if properly used. It is no longer indicated to use the actual cautery through the cystoscope in these cases. For a fuller discussion of this question see the chapter on the Use of the High Frequency Current in the Treatment of Tumors of the Bladder.

Intravesical Conditions Simulating Tumors of the Bladder.—Folds of mucous membrane and rugæ seen in a partially distended bladder, especially when associated with a chronic cystitis, with many rough muco-purulent tags projecting from the margin of the ridge, simulate very closely the more indefinite growths in the bladder. A vesical calculus which is lodged in a pocket, the edges of which have become swollen and inflamed, and the surface of the stone covered with muco-purulent material, may very closely resemble a tumor. Polypoid excrescences around the vesical neck and cysts of the ureter are easily differentiated by the smoothness of the mucous membrane covering their surface and their cyst-like appearance. A partially organized blood-clot adherent to the bladder wall and covered with muco-purulent or phosphatic material is sometimes confusing, but repeated irrigation of the bladder and a subsequent examination will clear up the diagnosis. An enlarged middle lobe of the prostate, with or without changes in its surface, can be differentiated from tumors near the vesical neck by establishing definitely the continuity of the growth with the rest of the prostatic mass. It may be said in passing that tumors originating from the prostate, especially carcinoma, do not, as a rule, grow out into the lumen of the bladder, but usually infiltrate the posterior wall, causing only slight changes in the trigone and the mucous membrane lining the bladder.

There are numerous extravesical conditions which may be confusing. They encroach upon the lumen of the bladder by pressure from without. Inflammatory conditions such as pus-tubes, pelvic abscess, and pericystitis, may cause tumefactions of the interior of the bladder which can be distinctly seen. If the inflammation is intense, the mucous membrane is swollen, injected, and edematous. In some cases a typical edema bullosum may be seen. A vaginal examination will serve to differentiate this condition. Fibroids of the anterior wall of the uterus frequently encroach upon the base of the bladder and may appear as growths of considerable size. In three such cases the vesical picture showed tumors in which the muscular walls of the

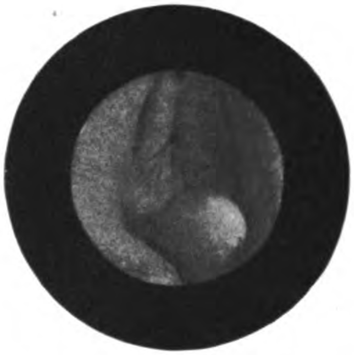


Fig. 172.—Cystoscopic picture showing an enlarged middle lobe of the prostate, resembling a tumor.

bladder had contracted somewhat about the neck of the fibroid, giving to it the appearance of a pedunculated tumor of the bladder. The mucous membrane covering such a tumor is, however, not changed, and is glistening white; the trigone is the only portion of the bladder which suffers from the pressure. The symptoms are frequent and sometimes painful urination. A pregnant uterus and enlarged cervix in a retroverted uterus and the normal fundus of the uterus when anteverted may press into the posterior wall of the bladder and appear as a tumefaction from within (Figs. 144 and 145). The symphysis pubis is especially well developed in women and sometimes appears on the anterior wall as a tumefaction when the bladder is distended with fluid. Some writers have discovered syphilitic lesions in the bladder, resembling flat epitheliomata, which can only be differentiated by the clinical history and the Wassermann reaction. With the exception of the enlarged middle lobe of the prostate and the intravesical conditions just described, there are very few conditions which will confuse the cystoscopist.

CHAPTER VI

STONE IN THE BLADDER

In less than half the patients suffering from vesical calculus the symptoms are sufficiently characteristic to allow of a correct diagnosis without the use of the cystoscope. The symptoms may be suggestive, but there are so many combinations of conditions which may exist within the bladder causing the same train of symptoms that the cystoscope is necessary to differentiate them.

The cystoscopist must decide—

1. Whether one or more stones are present in the bladder.
2. What is the situation of the stone? Is it free or is it encysted? Is it attached to any portion of the bladder wall? Does it occupy a diverticulum? Does it occupy the ureter opening?
3. Is the stone of renal or bladder origin?
4. Is there any lesion in the bladder or other cause predisposing to the formation of a stone which should be removed?
5. Is it possible to remove the stone by a crushing operation, or not?

Technic of the Examination.—Cystoscopy in cases of vesical calculus does not present any difficulty unless the stone is of such great size that the bladder cannot be properly distended, or the accompanying inflammation of the bladder is so intense as to be intolerant of the medium. The presence of stricture of the urethra, enlarged prostate, etc., need no special mention here.

The bladder is prepared for examination in the usual manner, leaving a little fluid in the bladder at the end of each irrigation. As soon as the viscus is properly distended the cystoscope is introduced, the light turned on, and the base of the bladder thoroughly examined for a stone. All hollow places and recesses must be carefully searched, especially the pouch which forms behind the interureteric band, and the recess behind an enlarged middle lobe of the prostate. When a stone is of large size (see Fig. 77), the impact of the instrument against the stone transmits an unmistakable sensation to the hand of the operator which is characteristic. If the stone is so large as to make examination impossible, we know that the best method for its removal is by suprapubic operation.

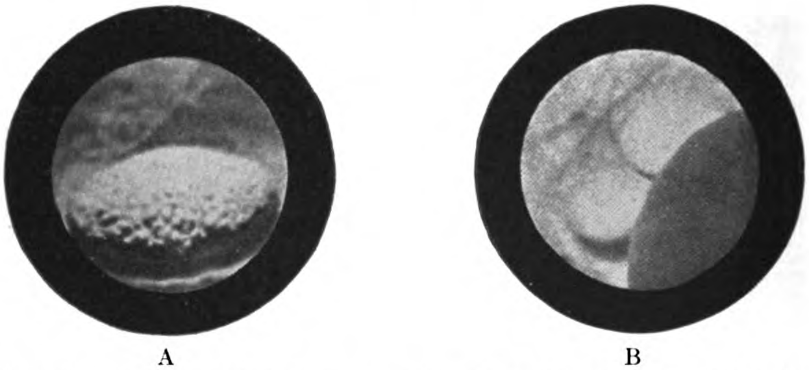
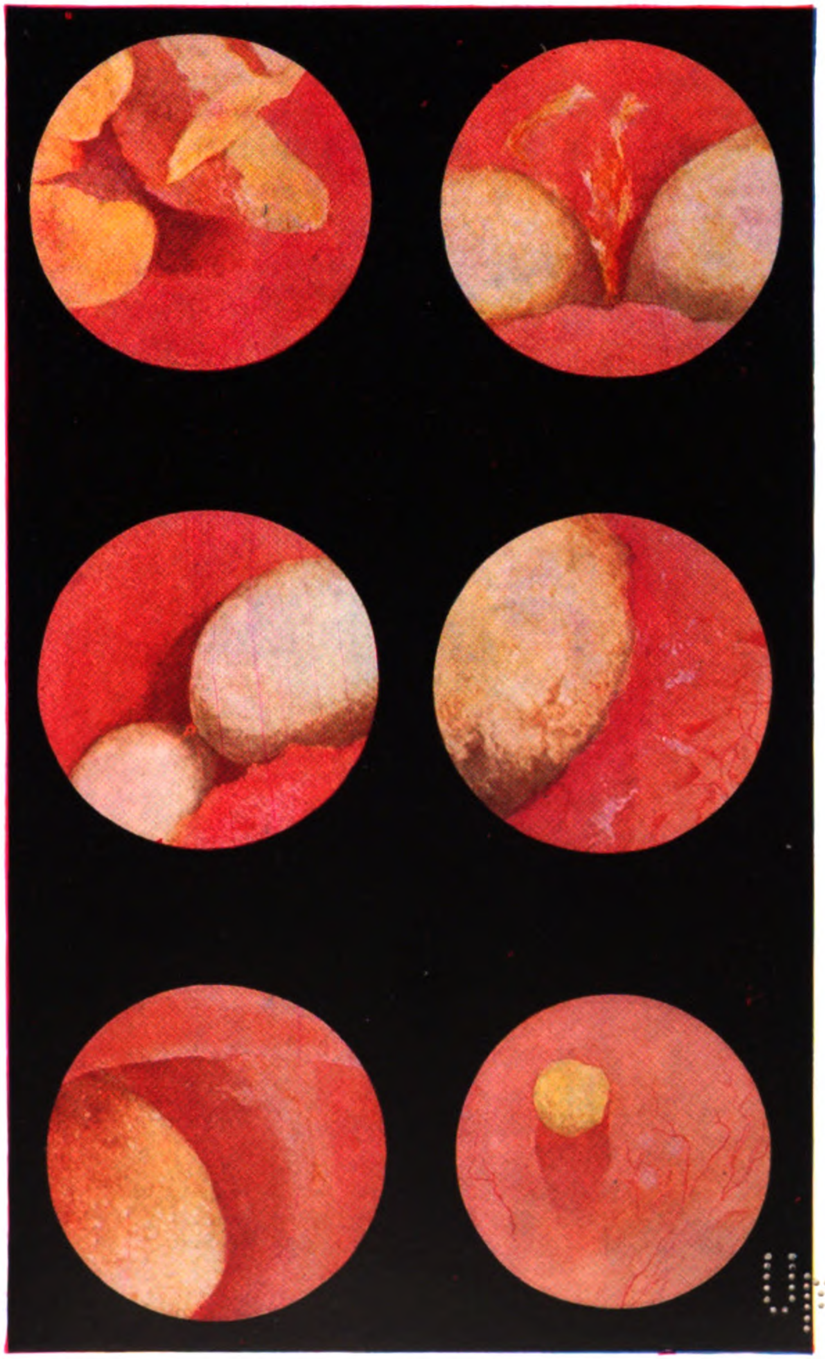


Fig. 173.—Cystoscopic pictures showing uric acid stones in the bladder (Nitze).

The greatest difficulty is in estimating the size of the stone. If it lies near the trigone, the size of the stone can be compared with the length of the interureteric band,

PLATE VIII



Showing the Cystoscopic Appearance of Various Types of Vesical Calculi in the Bladder (Otto Kneise, Handatlas der Cystoskopie) (Bremerman).

and after the operator has become expert in this class of cases, it is not a difficult matter to judge the size of the object viewed with considerable accuracy.

It is not sufficient simply to examine the base of the bladder, but the sides and vault must also be searched. A foreign body may be attached at any point of the vesical wall and a stone form about it. The writer has seen a number of foreign bodies encrusted with phosphatic salts—one, a piece of gauze evidently introduced at some former examination; and another, a hair, three inches in length, which was attached to the anterior wall of the bladder and encrusted with urinary salts. After its removal a second calculus formed at the same point on the anterior wall, and at the time of examination three formations had taken place in the shape of solid calculi attached to the anterior wall. Where diverticula are present, stones are likely to form in any part of the bladder, and there is no one site which is more frequently invaded than another. In the same bladder the writer has seen calculus formations in diverticula on both the anterior and lateral walls, and beginning formations of calculi in the openings of other diverticula. The number of calculi cannot always be determined unless they are of fairly good size.

Uric-acid Stones.—Uric-acid stones are hard, usually oval in shape, often multiple and sometimes faceted. They are reddish- or yellowish-brown in color, but may appear a much lighter yellow under brilliant illumination, or, if they are coated with phosphatic concretions, they appear white.

Phosphatic Stones.—Phosphatic stones are of all shapes, generally rounded, usually white; are soft and easily broken up, and sometimes are stained dark with blood.

Oxalate Stones.—Oxalate stones are brown or blackish in color, usually with a very rough surface and of the so-called mulberry form, but their surface may be smooth.

Phosphatic stones are most frequently formed in the bladder; oxalate and uric-acid stones in the kidney.

Cystin Stones.—Cystin stones are of rare occurrence.

The question of whether a stone is freely movable or not is of considerable importance, for it has happened in a number of cases that a small stone was seen protruding into the bladder from a diverticulum, while a much larger portion was contained within the diverticulum itself. Under such conditions the two portions of the stone are joined by a narrow neck which is easily fractured, and when a crushing instrument is used, the vesical portion is removed and that in the diverticulum is left behind. Also, if a stone is found attached to some portion of the bladder wall, it usually indicates some lesion at that point; and if an operation is done for the removal of the stone, the

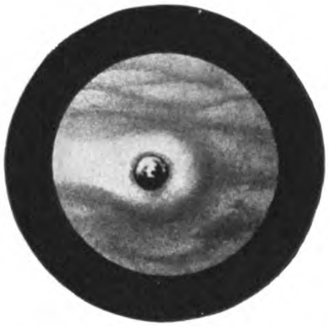


Fig. 174.—Cystoscopic picture showing an oxalate of lime stone blocking a ureter opening (Fenwick).

underlying area should either be excised or cauterized. It is important to recognize the presence of a stone in the ureter opening. If of small size, it can be removed through an operating cystoscope. If not, an operation should be done as soon as possible after its discovery, on account of the danger of atrophy of the kidney from blocking of its drainage-tube.

Is the Stone of Renal or Bladder Origin?—When we see a number of bright, shining, whitish, faceted stones in the bladder it is safe to conclude that they are of bladder origin, and have been there for some time. When we see numerous rounded or oval, reddish stones, resembling bird-seeds, or calculi of even larger size, we may safely conclude that they have descended from one or the other kidney, and a careful examination of the ureter openings may help to locate the side from which they have come. Cabot has called attention to the fact that the small round stones are commonly formed in the bladder behind an enlarged prostate. The safest test, however, is a shadowgraph taken with the *x*-ray.

Enormous single stones are usually the result of changes in the bladder.

A chronic cystitis, a foreign body in the bladder, a prostatic hypertrophy causing obstruction, often predisposes to the formation of a stone; also, occasionally, the inclusion of suture material or other foreign elements following an operation involving the bladder. After the removal of a stone, these causes should be treated as well.

Indications for Treatment.—Is it possible to remove a stone by a crushing operation, or not? This is a question for the individual operator, and it can usually be decided with accuracy in every case. Cystoscopic examination after a crushing operation is of greatest importance and often reveals a portion of unremoved calculus after it is supposed that the operation is complete. Many phosphatic stones of fairly large size can be safely removed by litholapaxy.

Objects in the Bladder Resembling Stones.—An old blood-clot lying on the base of the bladder, especially when the medium cannot be satisfactorily cleared, will often deceive even the most careful observer, and if one is not absolutely sure in his diagnosis in viewing the dark mass, a second examination should be made. This is especially true if methylene-blue has been used in the treatment of the case, for a stone becomes stained green after its use, as well as any other foreign body left in the bladder. Large collections of muco-pus rolled together on the base of the bladder may resemble a stone, and it is by no means easy to differentiate between a small phosphatic stone and a rolled-up mass of muco-pus which is more or less mixed with amorphous urates or phosphatic salts. Aside from these, there are very few objects which confuse us in this class of cases.

CHAPTER VII

MISCELLANEOUS DISEASES OF THE BLADDER

Leukoplakia Vesicæ.*—Knorr describes a rare disease of the bladder which gives a very typical cystoscopic picture. It is seen sometimes following a chronic cystitis, or during its course, or occurring alone in the bladder without other pathologic changes. The clinical symptoms are painful and frequent urination and hematuria. Through the cystoscope one sees sharply defined white flakes adherent to or incorporated in the wall of the bladder, resembling the well-known appearance of leukoplakia lingualis. The causation of this disease is not definitely known; we know that the white plaques originate from the cylindric bladder

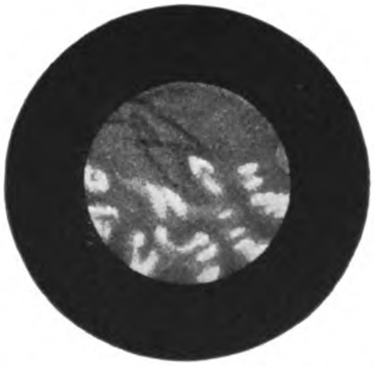


Fig. 175.—Cystoscopic picture showing leukoplakia of the bladder (Casper).

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* All the cases which have been followed and reported have ended in cancer.

epithelium. Nitze states that they occur only in cases of long-standing vesical irritation due to inflammation.

Abnormal Conditions following Operation or Injury.—Occasionally, resulting from an operation or injury, a fistulous tract forms between the interior of the bladder and some other portion of the body. It may lead to the intestine, the uterus, the vagina, the rectum, or the external abdominal wall. In the early stages of its formation, the vesical portion of the fistula is obscured by a massive edema. Later, the edema subsides, and if the fistula simply allows the urine to escape from the bladder, the vesical opening is not inflamed and appears generally as depicted in Plate V, p. 204. When, however, a fistulous tract enters the bladder from the intestine, the vesical end is congested and inflamed.

Varix of the Bladder.—This condition is not often encountered in the bladder. It occasionally is seen in old people, and as a complication of hypertrophied prostate. The varix consists of groups of dilated, thin-walled veins, similar in all respects to varicosed conditions as met with in other portions of the body. Cabot believes that varix of the bladder is not uncommon in women with varicose veins in the broad ligament.

The Diverticulated Bladder.—Acquired diverticula, as previously described, are generally a symptom of some obstruction of the urethra; however, the condition is frequently seen in the aged without known obstruction, and it is almost always a constant symptom of tabes dorsalis, and other lesions of the spinal cord. In this latter disease it may be quite as marked as in cases of hypertrophied prostate. It is an important sign in tabes, so much so that if we find a large amount of residual urine and a diverticulated bladder, without any obstruction in the urethra, we immediately suspect a lesion of the spinal cord.

Parasitic Diseases of the Bladder.—Parasitic diseases of the bladder are occasionally met with in this country, but, with the exception of the Bilharz disease, they are too rare to find a place here. Bilharz disease is caused by a parasite, the distoma hæmatobia Bilharzi. It is the cause of the so-called "endemic hematuria of Egypt." O'Neil * describes the cystoscopic findings as follows: "Congested ecchymotic patches, varying in size from one-fourth to one-half inch in diameter, are generally seen on the posterior wall of the bladder. These patches are usually covered with mucus, are raised up, and form slight tumefactions; they contain many ova." When the ova develop and escape from their bed in the bladder wall, they leave an excavated, bleeding patch, which gradually heals over. The symptoms produced by this disease are at first very slight. Hematuria appears, and an examination of the urine will show the presence of the characteristic ova. They are also found in the feces. Later, inflammation of the bladder occurs, renal and vesical calculi form, and abscesses develop. Anemia, exhaustion, and sepsis are present in the advanced cases. Spontaneous recovery often takes place.

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* "Boston Med. and Surg. Jour.," Oct. 27, 1904.

PART III

DISEASES OF THE PROSTATE

SENILE HYPERTROPHY OF THE PROSTATE

The Use of the Cystoscope.—No instrument which has been devised for estimating the size, conformation, and relations of a diseased prostate has proved more useful than the simple prismatic or correct-vision cystoscope in the hands of an experienced operator.

The cystoscope may be of great value and quite accurate in determining the size and contour of an intravesically hypertrophied prostatic lobe. The thickness of a prostatic "bar" may be measured, and the prostatic urethra may be explored.

For these uses it is necessary to have an instrument in which the reflecting prism is so constructed that objects, even though they be almost touching the surface of the prism, may be distinctly seen. One must, however, always make proper allowance for the magnification and possible distortion. For special use in cases of prostatic hypertrophy the writer has devised a cystoscope whose curve resembles that of an ordinary sound. There are no sharp angles, and the instrument is easy of introduction into the bladder. In fact, it is often possible to pass this instrument into the bladder in cases of prostatic hypertrophy even when a catheter cannot be introduced. In the ordinary case, in order to complete our examination, we first have the patient pass his urine and then we immediately introduce the small bladder cystoscope, measure the residual urine, wash out the bladder through the cystoscope, reintroduce the telescope, and make a further examination of the bladder. The essential points in the technic of the examination are as follows:

Technic.—The anterior urethra is made insensitive by the use of a 4 per cent. novocain solution. If the patient is supersensitive, two grains of alypin are deposited in the posterior urethra. The bladder cystoscope is then introduced as previously described. The bladder is filled with 200 to 500 c.c. of sterile water, or a 2 per cent. boric acid solution, and a thorough examination is made.

Conducting the Examination.—The base of the bladder and the ureter openings are first examined. This is essential, be-

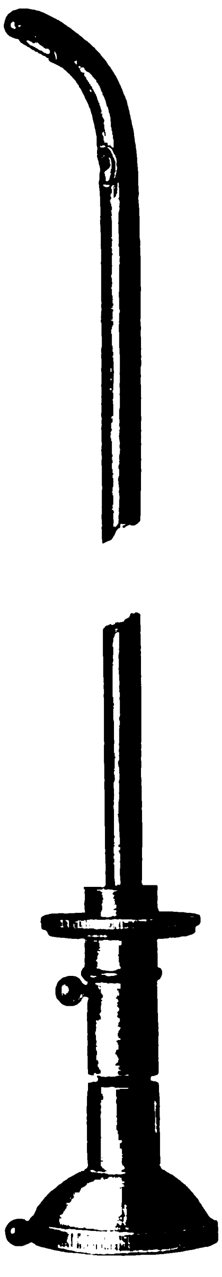


Fig. 176.—Pilcher prostatic cystoscope. A useful instrument for use in cases of enlarged prostate. It is simple, has the curve of an ordinary sound, and can often be introduced in cases where an ordinary catheter may not. It is to be especially noted that there are no angles, especially at the point where the beak joins the shaft.

cause there is frequently some bleeding caused by the instrumentation and the base of the bladder becomes quickly obscured. The urinary efflux is studied, diverticula, calculi, tumors, scars, and other pathologic conditions looked for, especially noting the presence and degree of trabeculation. This will give some idea of the effect of the obstruction on the bladder. Frequently, we find distortion of the ureter openings, but there is seldom interference with the urinary efflux unless the disease has progressed to the stage of involvement of the ureter and kidney. Then we may find dilatation and inflammation of the ureter mouths. Diverticula occur most frequently near the ureter openings and at the vertex of the bladder. If there is an insufficient quantity of fluid in the bladder, the base sinks down and it is difficult, and often impossible, to examine thoroughly the pouch which is formed below the prostatic bar or median enlargement of the prostate. This difficulty may be overcome by introducing more fluid, which will tend to elevate the base of the bladder so that

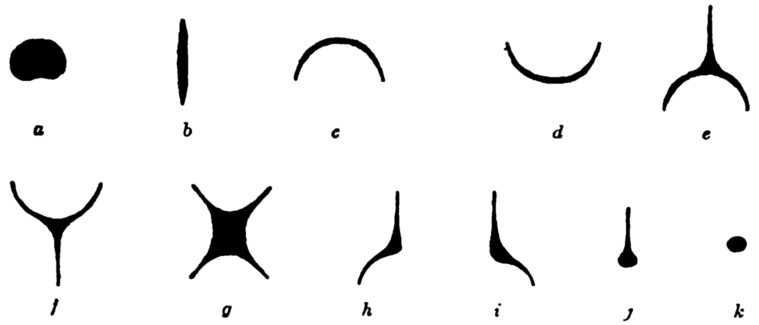


Fig. 177.—Diagram of changes in prostatic orifice (Young).

the trigone will come more fully into view. It is in this pouch, which forms mainly posterior to the interureteric band, that phosphatic concretions, diverticula, and stones are found.

As a result of chronic obstruction, the muscular structure of the bladder wall becomes greatly hypertrophied and thickened. In the earlier stages of prostatic obstruction, only a few of these bundles are seen crossing the wall; but as the obstruction becomes more complete, they appear as innumerable, well-developed, interlacing columns, resembling a latticework, with larger and smaller branches, much like the muscular structure seen on the inside of the ventricles of the heart (Fig. 178). The spaces between these bundles frequently show the openings of diverticula, which vary greatly in size and depth; sometimes stones are found within them. Such pockets, when infected, give rise

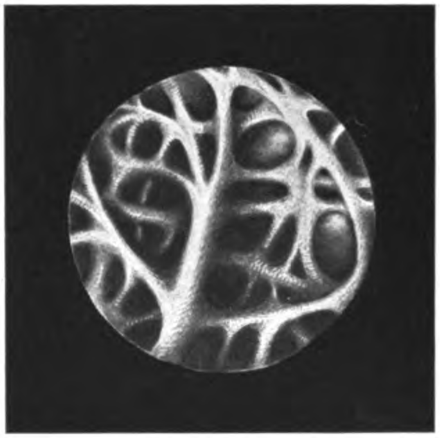


Fig. 178.—Cystocopic picture showing false diverticula in a trabeculated bladder—the result of disease.

to an intractable cystitis. The superior surface and sides of the bladder do not share equally with the posterior surface in this change.

In many cases of prostatic disease there is present in the bladder some evidence of inflammation. It varies from a simple hyperemia of the base to a severe general involvement of the viscus. In the chronic forms the mucous membrane is swollen and pale; with acute exacerbations, portions of the bladder appear more acutely inflamed, especially the trigone, but, as a rule, the rest of the bladder remains unchanged. This naturally depends upon the intensity of the cystitis. In the old chronic forms the bladder will be found covered with shreds of muco-pus and phosphatic concretions which are difficult to detach. If a stone of large size is present, a satisfactory examination cannot always be made.

Examination of the Prostate.—It must be remembered that in using the ordinary prismatic cystoscope, without the correct-view lens, the picture seen is inverted and considerably magnified. The newer lenses give a correct view with a magnified picture.

As the instrument is drawn back toward the urethra, after a thorough examination of the bladder has been made, the prostate will come into view and that portion of the organ covered by bladder mucosa can be carefully studied. Only a small portion can be viewed at one time. The operator should first view the entire orifice by turning the cystoscope through a complete circle. This gives an idea of the prostatic mass; any abnormalities may be noted, to be studied later in detail. The size and position of the median enlargement and its relation to the trigone and the ureter openings should be studied.

The normal prostatic orifice appears circular except at its posterior margin, which is flattened or slightly raised.

In bilateral enlargement of the prostate the anterior and posterior views show sulci of varying depths. As the instrument is turned around, the lateral lobes are seen to come together and project into the bladder.

In marked median lobe enlargement the position of the cystoscope as it enters the bladder may be so influenced that it will lie in a sulcus between the median lobe and a lateral lobe, and it is only by raising or depressing the shaft of the instrument that a correct idea of the true conditions can be obtained.

The picture presented by a cleft formed by two hypertrophied lobes depends upon the position of the cystoscope. If the cystoscope is pressed up into the sulcus, the lobes are separated and no cleft is seen. But as the beak is lowered, the lobes press together and the cleft can be seen.

In this way the prostatic orifice may be studied, and a fairly exact idea of the degree and character of the prostatic enlargement be obtained.

Of what value is the cystoscope in the diagnosis of obstructive prostatic hypertrophy?

By the use of the instrument all the necessary intraurethral instrumentation can be carried out; the presence of strictures determined; the length of the urethra measured; the amount of resistance in the prostatic urethra accurately felt by the hand; the amount of residual urine measured, and, in the great majority of cases, the presence of new growth or other obstructing intravesical conditions be excluded. The presence or absence of a calculus is always important to know beforehand, and this can be diagnosed with the greatest accuracy by the cystoscope. Oftentimes the presence of a stone in the bladder will cause sufficient congestion of a prostate to create obstruction. Furthermore, the exact position of the obstructing mass, be it a prostatic bar or a single ball valve median lobe enlargement, or a lateral lobe encroachment, or an anterior lobe obstruction, may all be determined before operation is undertaken. This knowledge may have an important bearing upon the character of the operation.

Before withdrawing the cystoscope, the lamp should be extinguished, and with the instrument still in the bladder and one finger in the rectum the thickness of the prostatic bar can be determined by drawing the beak of the instrument down and engaging the prostatic urethra between it and the examining finger. Any considerable thickening may in this way be easily felt (Hugh Young).

Dangers of Cystoscopy in Hypertrophy of the Prostate.—Fenwick states very positively that no patient over forty-five, suffering from nocturnal incontinence, great thirst, and morning nausea, should be subjected to cystoscopy. Fortunately, this combination of symptoms is rare. In cases where there is an enormous enlargement of the gland, cystoscopy is not necessary, but is not dangerous. The chief danger arises from rough handling and forcing the instrument through the prostatic urethra when there is great resistance. The obstruction can usually be passed by depressing the ocular end of the instrument. One needs simply to use the same precautions employed in any urethral catheterism.

Of what value is the use of the high frequency current in the treatment of prostatic obstruction?

This subject is discussed at length in the chapter on the use of the High Frequency Current in Lesions of the Bladder.

Cystoscopy after Preliminary Drainage of the Bladder.—It will be found that the cystoscopic picture will be considerably distorted after preliminary drainage of the bladder for retention of urine due to prostatic hypertrophy. The walls of the bladder do not distend as well. The pressure of the catheter is shown by a change in the prostate itself, and one would gain an erroneous impression from an examination made under these circumstances.

CHRONIC PROSTATITIS

As a rule, the cystoscope is not of any great value in the diagnosis of chronic prostatitis. It may, however, serve to differentiate between a chronic prostatitis and a median-lobe enlargement of the prostate. Where the median lobe is enlarged, the obstruction at the vesical neck is found to be caused by a smooth, rounded swelling which overlaps but does not necessarily encroach upon the trigone. With chronic prostatitis, the posterior segment of the prostatic urethra appears hyperemic, swollen, and infiltrated, so that when the instrument is pressed against it, it does not yield as easily as does the median-lobe enlargement. The swelling and infiltration may cause a slight bar formation with a pouch behind it, and the trigone itself may also be infiltrated and thickened.

TUBERCULOSIS OF THE PROSTATE

If tuberculous disease of the prostate, without involvement of the bladder, is suspected, the passage of a cystoscope or other instrument for examination is usually contraindicated. In the presence of severe bladder symptoms, it is justifiable to use the cystoscope. The prostate will be found to be irregularly enlarged and its surface hyperemic and granulated. The hyperemia and irregularity of the surface and the lack of extensive hypertrophy will often give a clue to the true condition of the prostate. In the more advanced cases, ulceration may be present, and if so, bleeding takes place very easily. Rectal examination in combination with visual examination of the organ and the almost invariable presence of tubercle bacilli will make the diagnosis easy.

In the two cases of primary tuberculosis of the prostate encountered by the writer he has not been able in either case to make a correct diagnosis by means of the cystoscope.

CARCINOMA OF THE PROSTATE

It is oftentimes very difficult and, in fact, impossible to make a diagnosis of carcinoma of the prostate from the cystoscopic examination. It must be remembered that the carcinomatous processes begin, as a rule, in or near the posterior commissure of the prostate and later involve the glandular elements. If, on making a section of the prostate, we find the glandular elements already involved, we feel that the process has extended so far that operation for a radical cure is impossible. Beginning in the posterior commissure, the disease extends toward the trigone of the bladder without, as a rule, involving the mucous membrane covering it. Rectal examination reveals the prostate with areas of dense induration, in places as hard as a stone. If the glandular elements have become involved, the entire lobe may feel like a calculus, but, as a rule, it is not very greatly enlarged. With a cystoscope, we find that although there has been considerable residual urine still there is no considerable hypertrophy or overgrowth of the prostate extending into the bladder. Secondly, the trigone is lifted up and is decidedly more prominent than normal, and does not shift its position with the filling or emptying of the bladder. We can see, at the same time, whether or not there is any involvement of the bladder mucous membrane.

CONDITIONS SIMULATING PROSTATIC DISEASE

1. Retention of Urine Due to Spinal Disease.—Diseases of the spinal cord affect the bladder by causing incomplete muscular control, resulting in partial or complete loss of its power of expelling the urine. The patient passes urine frequently day and night, but never empties the bladder completely. Cystoscopic examination shows no hypertrophy of the prostate or median bar formation. Young states that when disease simulating prostatic obstruction comes on late in life, and both rectal and cystoscopic examination show no hypertrophy or median bar formation, with a large residual urine, we should suspect spinal disease.

2. Vesical Tumors Simulating Prostatic Disease.— To differentiate between a vesical tumor and prostatic enlargement is not, as a rule, difficult. Some neoplasms, however, arising from or near the prostate are impossible of differentiation. If, however, we make an examination of the prostate and find that the prostatic body itself is not enlarged, or only slightly enlarged, and that at one point there is a decided outgrowth of new tissue, a vesical tumor may be suspected. As a rule, however, the tumor arises independent of the prostate, and by careful examination we are able to see a lack of continuity between the prostate and the growth, with a distinct area of normal vesical mucosa intervening. The ordinary papillomatous and ulcerating types of carcinoma are not difficult to differentiate. But a carcinoma involving the base of the bladder, or a carcinoma infiltrating the base without ulceration, are extremely difficult to recognize.

3. Vesical Calculus Simulating Prostatic Disease.— In patients over sixty-five years of age, a calculus may form so gradually that it is not suspected, the symptoms at no time being very severe. The first evidence of its presence may be due to the congestion of the prostate caused by a stone pressing against the prostate. The first symptoms are usually frequency of urination during the day. Many such cases have been operated on and the prostate removed, leaving the stone in the bladder, with the recurrence of the symptoms and the necessity of a second operation. Cystoscopic examination will, of course, clear up the diagnosis, and a suitable operation will relieve the patient of his prostatic and vesical symptoms. Vesical calculi are present in about 25 per cent. of all cases of prostatic hypertrophy. The stone may be found in the post-prostatic pouch or it may occupy a diverticulum. If a stone is found occupying a fixed position on the base of the bladder, it is extremely important to make a rectal examination in order to ascertain whether or not a portion of the stone is hidden in a diverticulum.

PART IV

DISEASES OF THE URETER

THE ureter is subject to the same diseases, both obstructive and inflammatory, as the urethra. The occurrence of *anomalies of development* are relatively more frequent in the ureter, and should always be kept in mind. It is not unusual, in the course of one hundred cystoscopic examinations, to find two or three cases of congenital malformation, the most frequent being a double ureter on one side. The importance of recognizing this is to be borne in mind, because two ureters may lead to different portions of the same kidney; one portion being diseased, and the other perfectly normal. As a rule, the diagnosis of this condition is not difficult except in those bladders where there is considerable trabeculation.

Dangers of Ureter Catheterism.—Those who are loudest in their condemnation of ureter catheterism are the ones who are the most ignorant of its true value. The writer has never met an expert cystoscopist who has had the slightest fear of doing injury to the patient by catheterizing the ureter. In the writer's own experience in catheterizing over five hundred ureters, and that of Kapsammer in double that number, neither can report any untoward effect following the employment of this procedure. In no case of the writer's has infection of a previously healthy

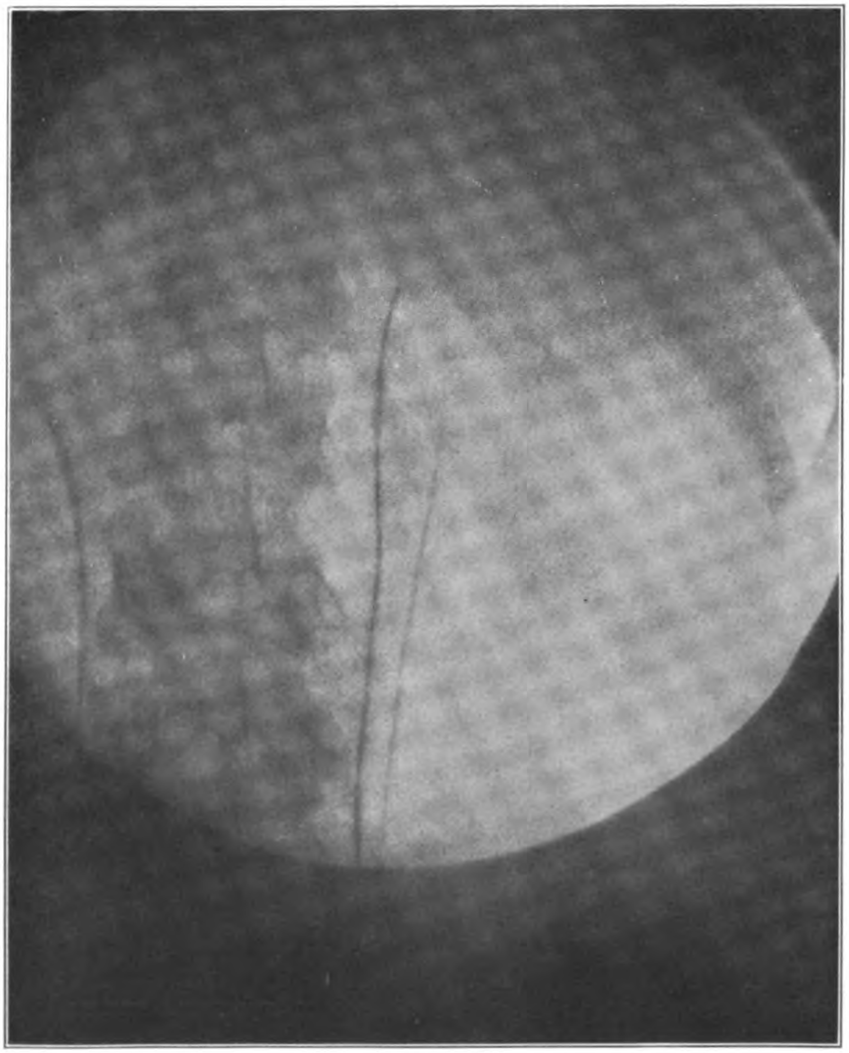


Fig. 179.—*x*-Ray skiagraph showing three ureters (F. Tilden Brown).

ureter followed, even when the bladder was diseased. Ordinary gentleness and care must be used to avoid accident.

Value of Meatoscopy.—If the lower third of the ureter is diseased, some change will usually be seen in the ureter opening. This is especially true of a descending calculus, tumor formation, and tubercular disease of the ureter below the brim of the pelvis. Diseases of the renal pelvis and kidney and upper two-thirds of the ureter often bring about some change at the ureter mouth, but in the writer's experience the appearance of the orifice is not sufficiently characteristic to allow a correct diagnosis to be made unless the lower third of the ureter is involved. Tuberculosis of the kidney, long-standing pyelitis, hydronephrosis, pyonephrosis, etc., often show characteristic changes at the ureteral orifice, but this is due to the pathologic changes in the lower third of the ureter which accompany these lesions.

PATHOLOGIC CONDITIONS OF THE URETER

STRICTURE OF THE URETER

Stricture of the ureter usually takes place at or near the lower orifice, and is seldom complete. All degrees of constriction may be seen, the most pronounced types resulting in a cyst formation of the vesical portion of the ureter which is plainly seen through the cystoscope (Figs. 159 and 180). Strictures of less degree are not usually followed by changes in the vesical portion of the ureter, but give rise to a dilatation of the ureter as a whole. The same factors which cause stricture of the urethra affect the ureter, *i. e.*, infection, trauma, etc. Gonococcus infection of the ureter is uncommon. Strictures of inflammatory origin are dilatable and are diagnosed by the inability to pass the ordinary ureter catheter, accompanied by extreme pain as the catheter approaches the point of stricture. The urine which escapes through the catheter contains pus and blood. The results of such a stricture are to obstruct the outflow of urine, to produce a dilatation of the ureter, and give rise to a hydronephrosis.

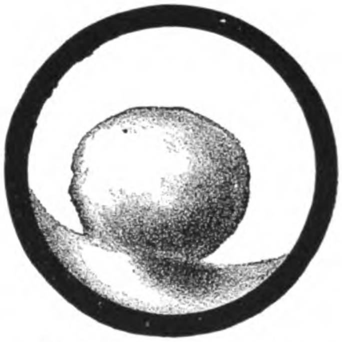


Fig. 180.—Cystoscopic picture showing a cyst of the lower end of the ureter (Nitze).

DILATATION OF THE URETER

Dilatation of the ureter may take place as the result of pressure on the ureter or anything which obstructs the escape of urine into the bladder. Such conditions are accompanied by pain and symptoms referable to the kidney of that side. The causes of long-continued dilatation of the ureter may be classified as follows:

1. **Due to Spinal Disease.**—A frequent manifestation of spinal disease is its effect upon the musculature of the ureter and bladder. Owing to the lack of innervation, the muscular walls of the ureter relax and the ureter becomes flabby and dilated. The lack of sphincteric action at the orifice of the ureter is shown upon cystoscopic examination by a dribbling of urine from the opening, by the flaccid, pouting lips, and by the larger caliber of the opening. It is found that two or three catheters of the ordinary

size can easily be passed into the orifice of the ureter without causing pain. The condition is almost always bilateral and is more or less serious in its consequences.

2. Due to Back Pressure from Obstruction in the Urethra or in the Bladder.—Such a condition is seen most frequently as a result of stricture of the urethra, enlargement of the prostate, or tumor of the bladder. The walls of the ureter become hypertrophied and, if the obstruction is not relieved, the ureters share in the general dilatation. This is, however, a late manifestation. As a rule, the efflux of urine from the meatus is strong and the walls of the meatus considerably hypertrophied.

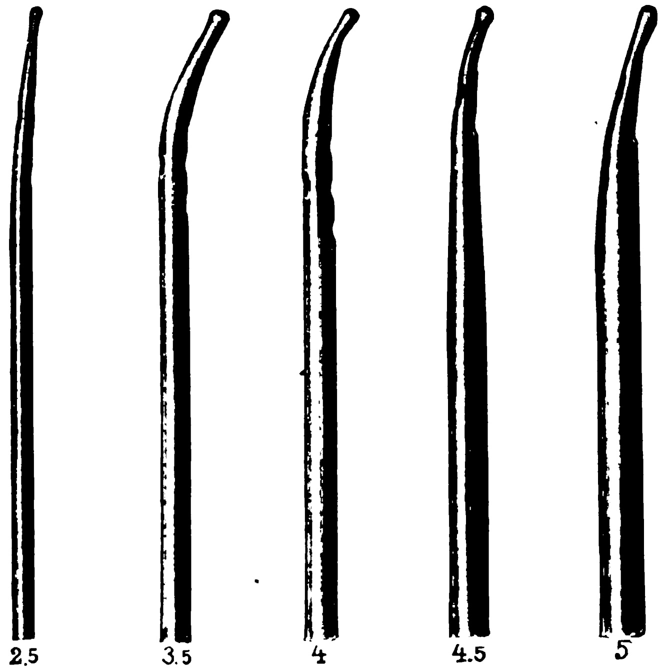


Fig. 181.—The Kelly ureteral dilators.

3. Due to Pregnancy.—It has been found by many observers that in the majority of pregnant women the ureters are dilated, due possibly to direct pressure of the enlarging uterus and to changes in the innervation of the muscular walls of the ureter. Examination of the ureter mouths does not show much change. The efflux of urine is weak, but the rhythm still shows a perfect peristaltic action. As a result of the dilatation of the ureter, pyelitis occasionally develops. The diagnosis is confirmed by passing a catheter into the ureter and determining the presence of a dilatation above the brim of the pelvis; the urine collects rapidly without much rhythm to the dropping.

4. Due to Mechanical Obstruction.—This is probably one of the most frequent causes of dilatation of the ureter, and follows a number of different causes which will shortly be considered under the heading "Obstruction of the Ureter." If the obstruction is not complete, dilatation follows, but when the obstruction becomes complete, the functional activity of the kidney is lost and no dilatation occurs. The ureter itself shares late in the dilatation, the pelvis of the kidney being first affected. If the diseased condition of the ureter, or pressure thereon, occurs in the lower third, some change may be noted in the bladder, but, as a rule, the condition is entirely mechanical. The flow of urine from the ureter opening is seen to be diminished and occurs at irregular intervals; if the catheter

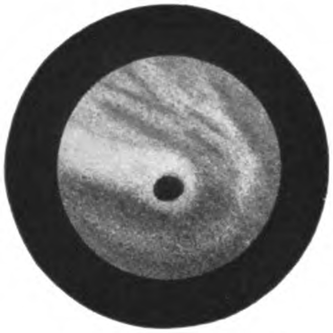


Fig. 182.—Cystoscopic picture of a dilated ureter opening (Fenwick).

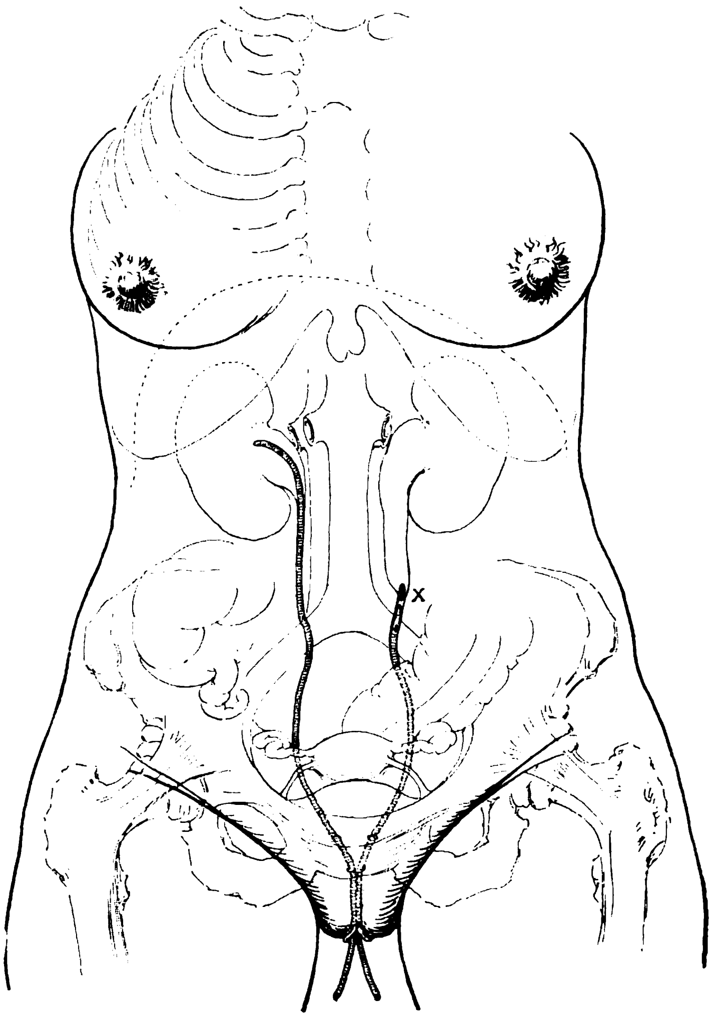


Fig. 183.—Method of estimating exact position of a ureteral obstruction (Kelly). The ureter catheter may or may not be passed to the pelvis of the healthy kidney; a catheter is passed into the other ureter until it reaches the obstruction X. The length of the catheter contained within the ureter indicates the distance of the obstruction from the ureteral orifice.

can be made to pass the obstruction, the residual urine which has collected above that point will flow rapidly in steady drops without rhythm.

5. Due to Inflammatory Diseases of the Ureter.—This occurs most frequently in the vesical portion of the ureter, due either to extraureteral or intraureteral causes. The changes in the bladder wall itself frequently give some clue to the extent of the obstruction, but unless a foreign body is present in the ureter or an inflammatory exudate of some size is pressing upon the ureter, the dilatation is not marked. In tubercular diseases of the ureter, the dilatation is irregular, owing to multiple strictures of the ureter and an uneven involvement of the tube.

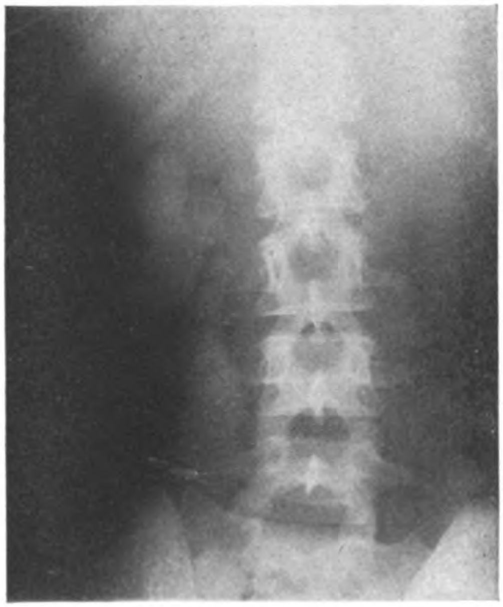


Fig. 184.—Case of hydronephrosis and hydroureter caused by obstruction low down in the ureter. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

OBSTRUCTION OF THE URETER

Aside from the conditions already mentioned as causing dilatation of the ureter, we have three distinct types of obstruction of the ureter with symptoms sufficiently characteristic to allow of a differential diagnosis:

1. Obstructions due to anomalous renal blood-vessels.
2. Obstructions due to tubercular disease of the ureter.

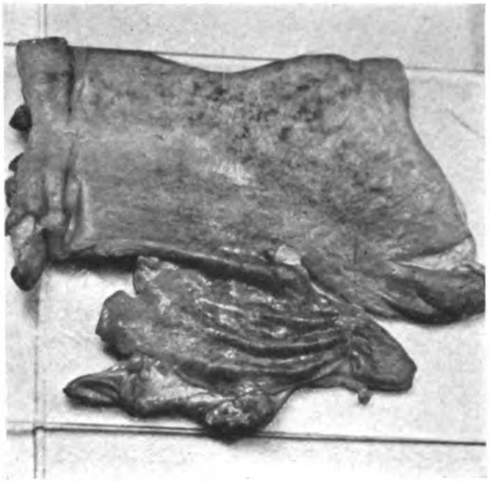


Fig. 185.—Photograph of a section of dilated ureter following tubercular strictures of the vesical portion of the ureter.

3. Obstructions due to a calculus impacted in the ureter.

1. Obstructions Due to Anomalous Renal Blood-vessels.—This condition has been found more or less frequently, and is characterized by a soft obstruction 25 to 27 cm. from the orifice of the ureter. As the ureter catheter reaches the obstruction, there is a soft obstruction which is appreciable to the hand of the operator. One seldom can judge of the character of the obstruction, however, from this fact. There is seldom bleeding, but there is always present some degree of hydronephrosis. For a more detailed description, refer to the chapter on "Hydronephrosis."

2. Obstructions Due to Tuberculosis of the Ureter.—The chief obstruction is usually at or near the vesical end of the ureter, and there are generally multiple points of obstruction due to the formation of multiple strictures. They may occur at any point in the course of the ureter. The changes in the vesical mucous membrane surrounding the ureter opening are characteristic. Tubercle bacilli and pus are also present in the urine.

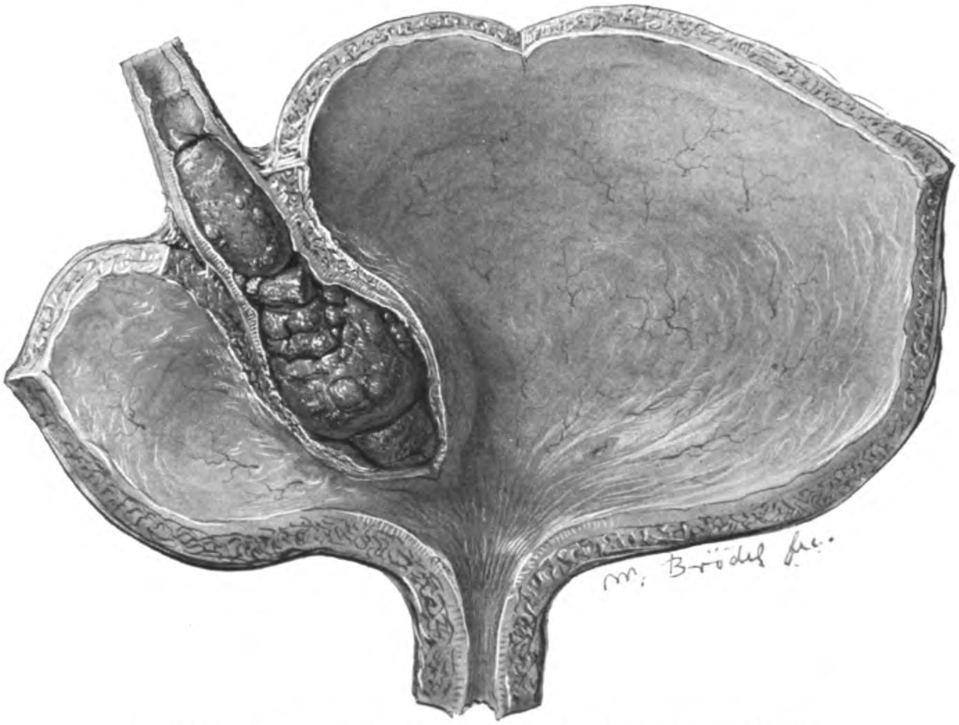


Fig. 186.—Calculus lodged in the vesical end of the ureter (Kelly).

3. Obstruction Due to Calculus Impacted in or Descending the Ureter.—The diagnosis of this condition is by no means simple, and involves an understanding and appreciation of the history of calculus formation in the kidney and ureter, and the pathologic changes which accompany a shifting obstruction. We may have a small smooth stone entering from the renal pelvis and passing on into the bladder without giving rise to any symptom

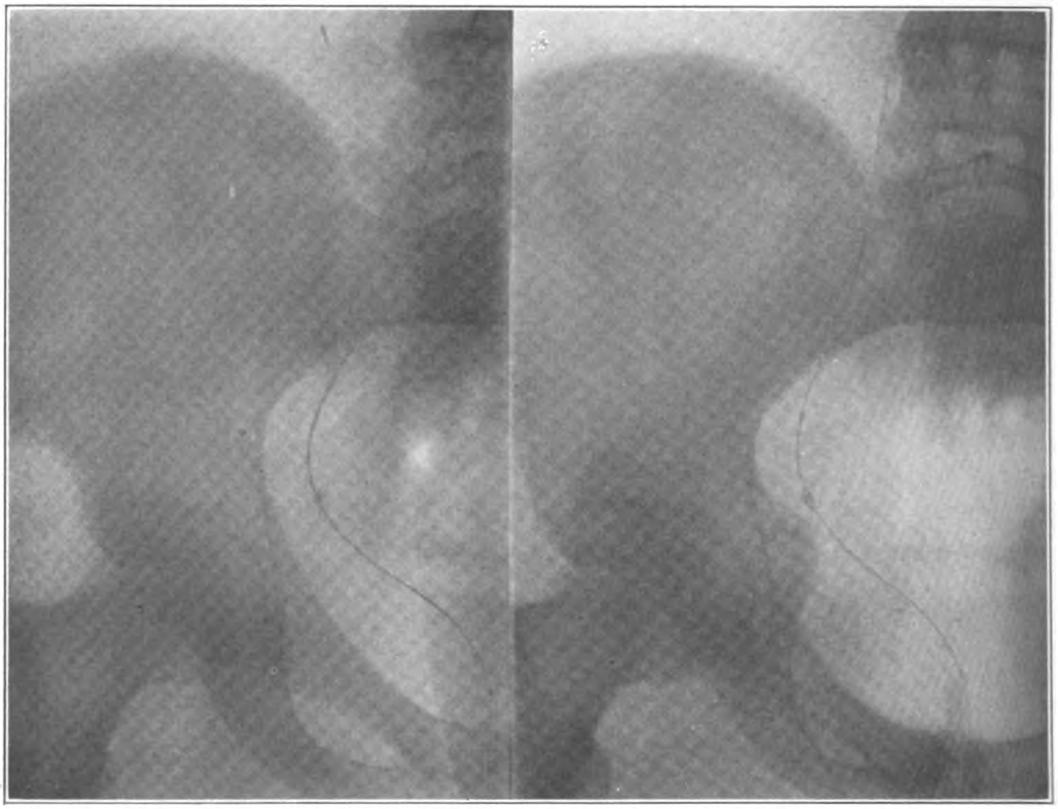


Fig. 187.—*x*-Ray skiagraph showing a stilet outlining a section of the ureter, and a small calculus descending the ureter (F. Tilden Brown).

other than a transient discomfort. We may have a larger stone entering the first portion of the ureter and becoming impacted there. It may become dislodged and be forced back into the renal pelvis. We more often have a stone which passes into the ureter and gradually works its way down into the vesical portion of the tube. It may become impacted at any point along the ureter and remain there indefinitely, usually, however, being forced lower and lower. If the stone only partially obstructs the passage of urine, hydronephrosis is produced. If there is a complete obstruction, lasting for four or five days, we usually have a disappearance of the functional activity of the kidney of that side without hydronephrosis; infection developing at the point of impaction of the stone leads to hydronephrosis or pyonephrosis.

As to the *location* of the stone, 30 per cent. of the cases show the stone arrested near the pelvis of the kidney; 15 per cent., near the brim of the pelvis, and 55 per cent. of the cases show the stone impacted in the vesical portion of the ureter.

Effect upon the Ureter.—At the point where the stone becomes impacted the ureter is inflamed, swollen, and sensitive, and may become ulcerated. Above the stone, the ureter is dilated; below the stone, the ureter is swollen, edematous, and bleeds easily.

Effect upon the Kidney on the Opposite Side.—The kidney becomes swollen, hyperemic, and secretes more readily. There may be a sudden bilateral anuria due to reflex secretory inhibition.

Diagnosis.—The history of the case is of great importance. Usually there are recorded a number of previous attacks of varying severity. Pain is rarely absent, and generally is located primarily at one of the three points of the ureter above mentioned. It is very severe, recurring in acute paroxysms, usually with periods of relief. The pain radiates downward along the course of the ureter to the groin, testicle, or leg. At times it is dull and indefinite. Nausea occurs, as a rule, in severe cases, accompanied by fever. The urine may be perfectly normal, but, as a rule, we find blood present in varying amounts. The quantity of urine

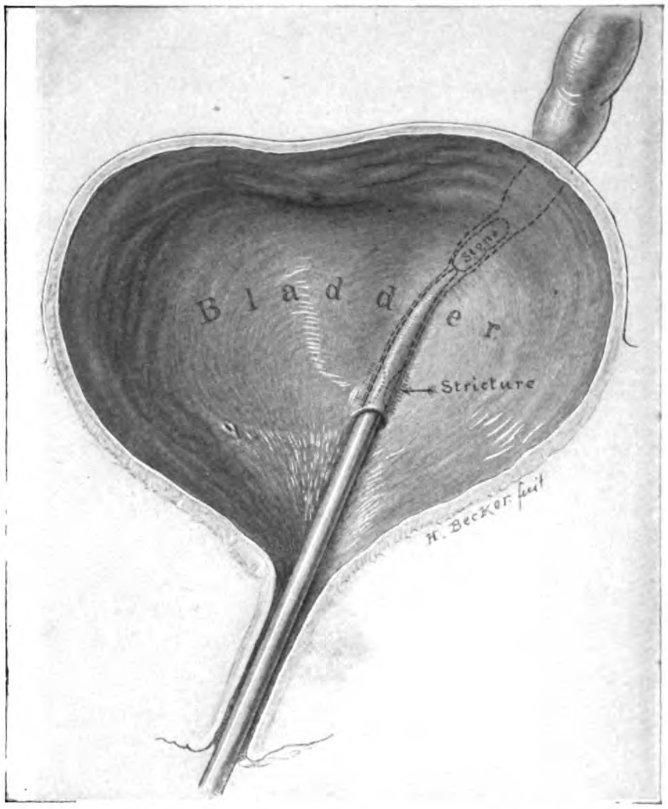


Fig. 188.—A strictured ureteral orifice with stone lodged above it (Kelly-Noble).

passed is not of great diagnostic value, as the kidney of the opposite side may become extremely active or be functionally inactive, due to reflex inhibition. A temporary complete or partial obstruction with hydronephrosis may be followed by sudden relief, with great increase in the amount of urine passed. The physical examination may aid us, especially if the stone causes sufficient irritation to give rise to symptoms of inflammation or tenderness along the course of the ureter. The rectal or vaginal examination will occasionally demonstrate the presence of a stone, if it is located in the vesical portion of the ureter or anywhere below the pelvic brim.

Cystoscopy.—The presence of a stone in the ureter does not give rise to cystitis other than a local hyperemia and edema along the course of the affected ureter. If the stone is impacted in the vesical portion of the ureter, it will show as a tumefaction occupying the line of the ureter. The overlying mucous membrane of the bladder is usually enormously swollen, but may not be.

A Stone Descending in the Ureter.—A stone impacted in the lower third of the ureter usually causes considerable change at the meatus. There is some protrusion of the mucous membrane of the ureter due to swelling and edema. The ureter opening and the surrounding tissue is obscured in a mass of edema; the lips of the opening are roughened and irregular, and difficult to make out. If the stone is a large, smooth one, the changes may not be so marked, and we often find bright, red punctiform extravasations around the ureter opening; the corresponding side of the interureteric bar becomes infiltrated and swollen; the mucous membrane is of a dull red color, with bright red spots of ecchymosis. If the stone becomes impacted and does not change its position, the active inflammatory phenomena subside. If the stone is confined to the upper or middle third of the ureter, there are, as a rule, no changes in the ureter opening itself.

Urinary Efflux.—When the stone is impacted in the lower third of the ureter, the urinary efflux is lessened in amount, whereas, when the stone is higher up in the ureter, the urinary stream, as a rule, is ejected rapidly and in large amounts.

Stone Impacted in the Vesical Portion of the Ureter.—If the stone is of recent origin, the changes in that section of the bladder embracing the ureter are very marked. There is, as a rule, a considerable extravasation of blood beneath the mucous membrane, accompanied by an enormous edema which entirely obscures the orifice of the ureter. The edema forms a considerable mass and is frequently translucent. As the stone advances and presents itself at the orifice (Fig. 174) it may be seen as a brown or whitish foreign substance blocking the opening of the ureter, usually indistinct unless the stone has been present there for some time. A stone in this portion of the ureter is almost invariably accompanied by severe vesical symptoms of pain and frequent and difficult urination. If the stone becomes arrested here, the edema gradually lessens and the stone becomes covered with phosphatic concretions.

There is no other condition in the bladder which is easily confused with that of a stone impacted in the lower portion of the ureter. The symptoms of the condition are characteristic, the paroxysms of pain are persistent, and the edema and swelling along the course of the ureter and surrounding the ureter opening are quite characteristic.

After a Calculus has Passed into the Bladder.—After a stone has passed into the bladder the lips of the opening are swollen and bruised, and frequently show lacerations. This condition, however, rapidly recedes, and within a few days the erosions and inflammatory reaction disappear.

Ureteral Catheterism.—With the ordinary silk catheter passed into the ureter opening an obstruction is felt when the stone is reached. There is pain, as a rule, and the mucous membrane bleeds easily. If it is possible to force the catheter past the obstruction, it passes on with a sudden jump, and usually there is an increased flow of urine from the catheter.

If a stiletted catheter be used and an x-ray picture be taken, the shadow of the stone in the ureter and that of the wire stilet will coincide (Fig. 187); a wax-tipped catheter, as first suggested by Kelly, of Baltimore, may be used. As a catheter covered with wax passes the stone, it will be marked by the rough surface of the stone (Fig. 189).

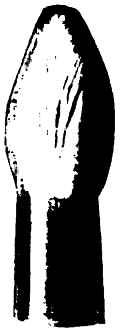


Fig. 189.—Kelly's wax-tipped ureteral catheter with scratch marks (Kelly).

Technic of Burton Harris Method of Diagnosis.—This method depends on the same principle of a scratch on a wax-tipped catheter or filiform, as devised by Kelly. The technic is as follows:

A No. 3 F. tapered whalebone filiform, 75 centimeters in length and having an olivary tip, is *first* passed through the cystoscope, the tip being allowed to extend beyond the deflector for a distance of 15 centimeters greater than the length of the catheter channel. In the female the 15 centimeters is of itself sufficient. The tip is then prepared by dipping quickly into melted beeswax. Occasionally the first drop will congeal in the desired size and contour. More often it is necessary to enlarge the bulb by dipping again after the first coat has been allowed to harden. The tips here illustrated measure from 6 to 8 F. Occasionally a ureteral orifice may be found too small to permit of the introduction of the ordinary bulbous wax tip. In such cases a wax spindle on the shaft of the filiform, 2 or 3 centimeters from the tip, will pass quite readily, the distal end of the filiform acting as a guide. Such spindles are easily made by dipping and quickly holding the filiform point *upward* while the wax is still fluid. The integrity of the wax surface having been established by examination under a lens,

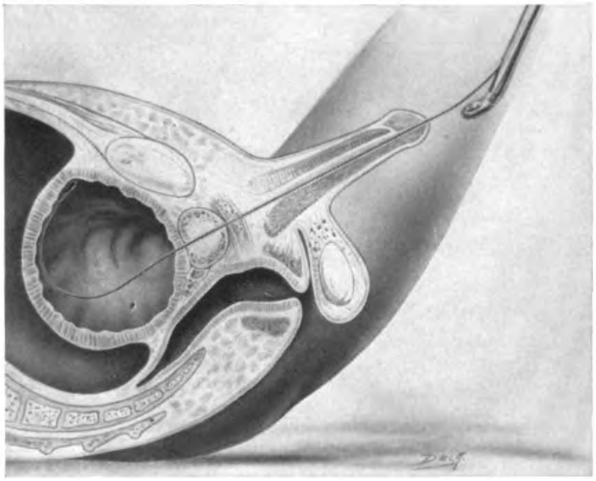


Fig. 190.—Wax-tipped filiform in bladder and cystoscope about to be guided over it (Harris).

the filiform is lubricated and the tip introduced into the previously distended bladder; the cystoscope then being guided over it after the manner of a tunneled sound (Fig. 190).

On illuminating the viscus, the filiform is found partly coiled; the tip, owing to the resiliency of the whalebone, lying flat against the bladder wall or being buried in the soft mucosa (Fig. 191). It is this factor which reduces to a negligible quantity the possibility of accidental abrasion of the wax by the beak of the cystoscope. The deflector is now raised and the filiform cautiously withdrawn until the perfect tip presents in the center of the field (Fig. 192).

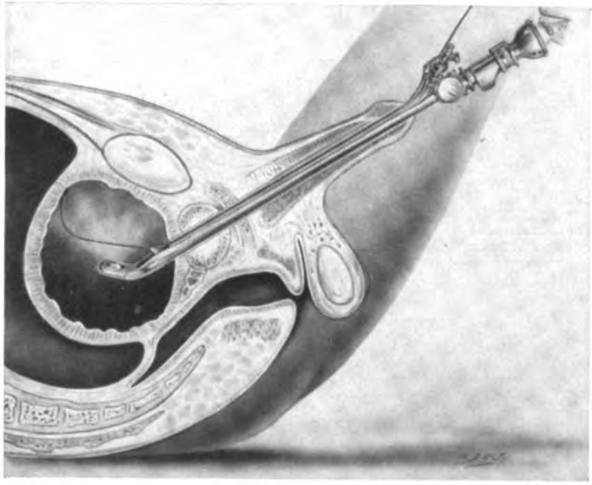


Fig. 191.—Deflector has been raised and filiform is being withdrawn (Harris).

In exploring the ureter a decided jump is sometimes observed in that portion of the filiform between the deflector and the ureteral orifice. In event of such partial obstruction being due to calculus, the chances of obtaining a scratch would obviously be increased by causing the wax tip to pass over the point several times. On completing the exploration, the filiform is again withdrawn until the tip presents in the center of the field and within the focal distance of the instrument. When the fluid in the bladder is clear and the wax is not covered by blood or mucus, it may be inspected through the cystoscope by slowly rolling the filiform between the thumb and finger. In event of a positive result one may remove the filiform and proceed with the routine catheterization of the ureters, thus obviating the necessity for reintroduction of the cystoscope. If, however, there is any doubt regarding the presence of a scratch, it is better to withdraw the cystoscope, the tip being allowed to remain either in the ureter or on the upper wall of the bladder until after the beak of the cystoscope has left the posterior urethra. The tip is then washed in cold water and examined under a lens.

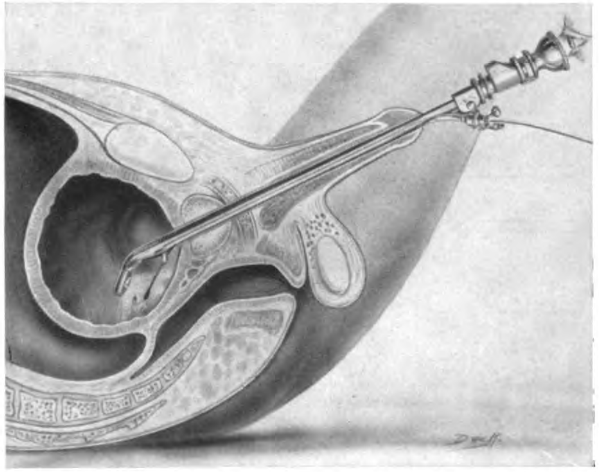
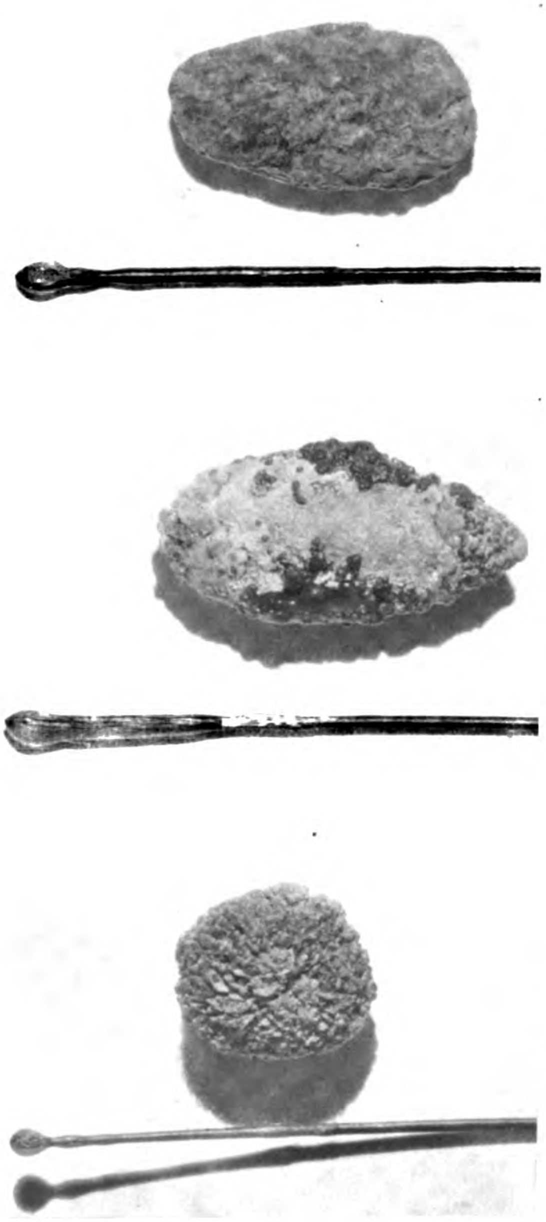


Fig. 192.—Perfect wax tip is now ready for ureteral exploration (Harris).

The advantage of this method is that it can be used in



Case 1. Case 2. Case 3.

Fig. 193.—Photographs (× 4) showing character of calculi and scratches on wax-tipped whalebone filiform ureteral bougies, in three recent cases (Harris).

the male, and it gives us very definite information. If the radiograph and wax-tipped catheter are both negative, we are justified in making an absolute statement that there is no calculus in the ureter. The combined methods are much safer than pyelography.

x-Ray Diagnosis of Ureteral Calculus.—It is not necessary to dwell upon this phase of the subject longer than to say that unless the shadow which is seen upon the photographic plate coincides with an opaque catheter in the ureter, a positive diagnosis of the ureter stone should be questioned. If, however, the ureter be catheterized with a special opaque catheter, and the shadow of the *x*-ray plate coincides with that of the stilet and an obstruction has been met with at the point indicated on the photographic plate, a diagnosis of ureteral stone can be definitely made. Where a calculus occupies the lower third of the ureter, the cystoscopic picture is more to be relied upon than the *x*-ray plate, on account of the frequent occurrence of phleboliths in the pelvic veins (Fig. 194). When a calculus is lodged in the upper portion of the ureter, the *x*-ray is more valuable.

Note.—There are certain cases, by no means rare, in which a stone finds its way down to the lower end of the ureter without producing any pain.

Normal urine occurs in about 1 per cent. of the cases.

In about 10 per cent. of the ureter stone cases the catheter passes without obstruction and there is no change in the ureteral orifice (Hugh Cabot).

Indications for Treatment.—If a small calculus is discovered in the lower end of the ureter, the ureteral opening should be dilated by appropriate sounds, and

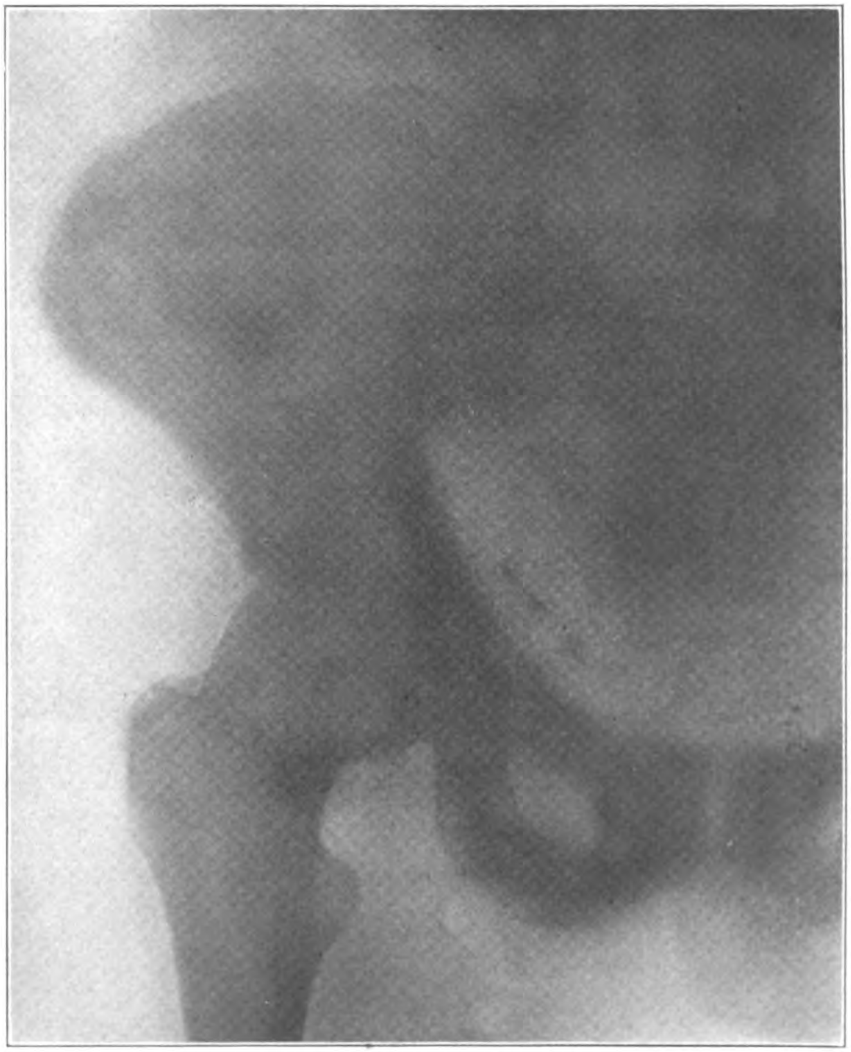


Fig. 194.—*x*-Ray skiagraph of pelvic phleboliths. The shadows cannot be differentiated from those cast by calculi. It is necessary to pass a stiletted catheter, and then if the shadow of the stilet and that of the opaque body are in the same line it is fair to assume that a calculus is present (Fig. 187). If not, the shadows are probably due to extravesical lesions (Fig. 195) (Brown).

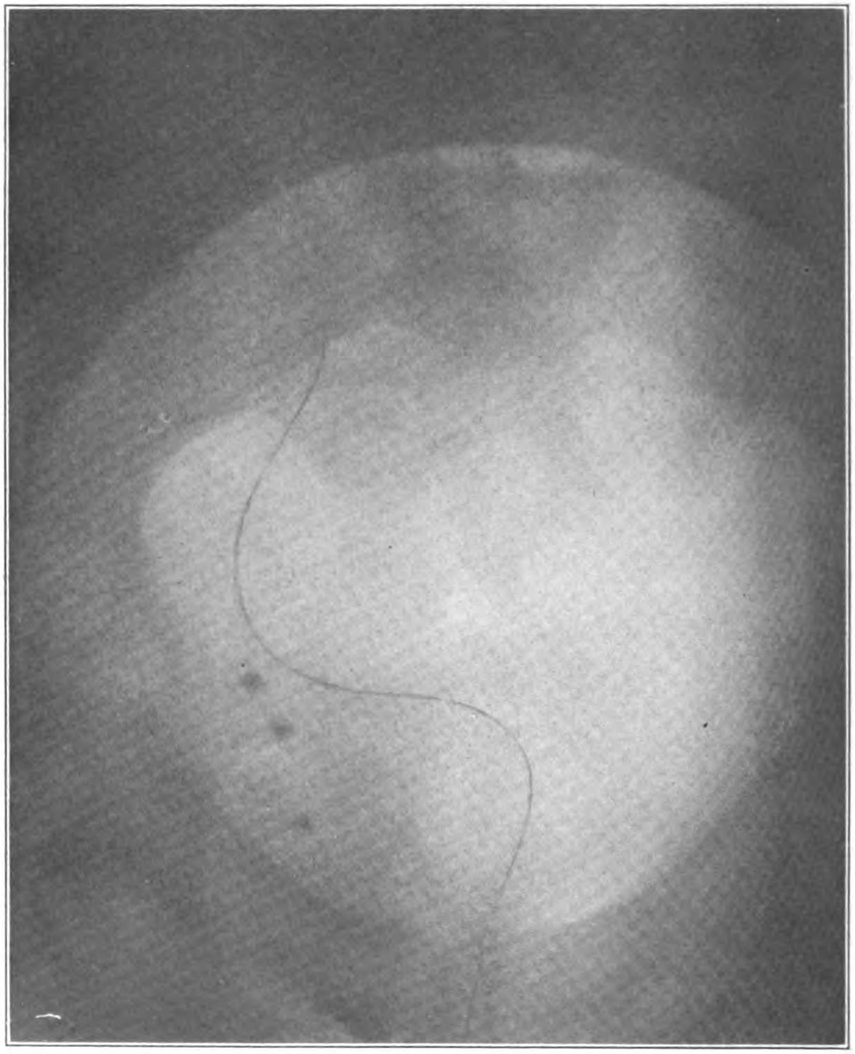


Fig. 195.—*x*-Ray skiagraph of phleboliths with wire stilet in ureter (Brown).

attempts made to dislodge it. Using the ureter catheter, injections of cocain may be made in the region of the calculus and oil injected above and below the obstruction. A calculus may in this way be freed and pass on into the bladder. Again, through a proper endoscopic tube forceps may be introduced and the stone forcibly removed from the ureter. Also the ureter opening may be cut or the stone removed, as described later in the chapter on High Frequency Therapy.

URETERAL FISTULÆ

Occurrence.—Ureteral fistulæ occur usually as a result of some traumatic or operative injury to the ureter; they may follow necrosis and gangrene of a circumscribed portion of the ureter due to pressure or as a result of cutting off the blood-supply from that section. A fistula resulting from traumatism may occur at any point in the course of the ureter. A fistula developing as the result of injury to the ureter or necrosis is found usually close to the uretero-vesical junction.

Diagnosis.—The history of the case is of prime importance. Most frequently it will develop that there has been some extensive operative attack upon the pelvic organs, either a carcinoma of the uterus or wide-spread inflammation. If the ureter has been cut across, urine will be found escaping from the wound within the first twenty-four hours. If the fistula is not established for a number of days it probably is the result of pressure or localized gangrene of a section of the ureter. The fistula may be uretero-abdominal, uretero-vaginal, uretero-uterine, uretero-intestinal, or uretero-rectal.

In women, the question frequently arises, Is the constant soiling or escape of urine following a pelvic operation due to paralysis of the urethral muscles or due to a uretero-vaginal fistula?

Does a Fistula Exist?—It is necessary first to establish the fact that urine is escaping from the ureter without passing through the bladder. This may be done by administering methylene-blue or indigo-carmin to the patient and packing the vagina with a long strip of white gauze. If the urine is escaping through an abdominal sinus, or through any other wound, the blue color of the solution administered will quickly appear on the dressing covering the wound. If there is a uretero-vaginal fistula, the section of gauze which fills the vault of the vagina will be stained blue, while that occupying the lower part of the vagina will not be stained. In this simple way we may establish the presence of a fistula.

From what Section of the Ureter does the Fistulous Tract Start?—A cystoscopic examination is made. If the wound of the ureter is of long standing, no changes will be noted in the region of the ureter opening; if of recent occurrence, the ureter opening corresponding to the injured side will show congestion and edema. If there is a partial wound of the ureter without severing the entire lumen of the same, we will see the same rhythmic contraction of the opening of the sphincter without any urinary efflux appearing. If the entire ureter has been severed there will be no peristaltic wave appreciable, as a rule. Several cases have been reported in which contraction of the distal end of the ureter was observed after nephrectomy (Cabot).

A catheter entered into the injured ureter will pass easily as far as the point of the injury; usually it will meet an obstruction at this point due to cicatricial contraction. The patient will always experience pain when the catheter reaches that point. If the opening in the ureter is large enough, the catheter may pass on into the fistulous tract, but this is exceptional.

Indications for Treatment.—If the uretero-vaginal fistula arises at the uretero-vesical junction, in the absence of infection of the kidney, the opening into the vagina may be located and its closure stimulated by using the actual or electric cautery. If the ureter defect is higher up along the pelvic portion of the ureter, it is useless to try any vaginal application; the strictest toilet of the vagina should be practised in order to avoid infection of the kidney. The propriety of exposing the proximal end of the severed ureter and implanting it into the summit of the bladder by means of a suitable abdominal incision must be considered. If infection of the kidney is present, with long-continued temperature, nephrectomy is indicated, if the second kidney is functionating normally.

WOUNDS OF THE URETER

These are occasionally met with either as the result of operation or injury, and have been discussed under the heading of "Fistulæ." With a partial injury we expect to have bloody urine secreted from the ureter opening. If we suspect a rupture of the ureter, we may use the cystoscope to observe the ureter opening, but no catheter should be passed into the ureter.

PART V

THE FUNCTIONAL ACTIVITY OF THE KIDNEYS

INTRODUCTION

THE determination of the functional sufficiency or impairment of the kidney has not yet reached a state of scientific exactness. The more we study the question, the more we become convinced that there are so many qualifying factors entering into the problem that any test which takes into account the kidney excretion alone is apt to be incorrect. There are *three distinct factors* which must be considered, which may roughly be designated as *prerenal, renal,* and *postrenal.*

The prerenal factor comprises the vascular, nervous, lymphatic, and digestive systems.

The renal factor concerns the kidney itself; the condition of the parenchyma; the amount of secreting surface affected by unnatural states in the prerenal and postrenal systems; the degree of pathologic change present, and its extent; conditions of disease existing in the calices and renal pelvis, *i. e.*, dilatation, inflammation, new-growth, calculus, etc.

The Postrenal Factor.—Meaning by this, conditions of disease or mechanical obstruction existing in the ureter, bladder, or urethra, which would seriously alter the functional sufficiency of the kidney, the kidney itself being capable of complete renal sufficiency as soon as the disease or obstruction along the urogenital tract is removed. A thorough understanding of this last statement is absolutely essential to the proper determination of renal sufficiency.

For example, the correlation of urinary obstruction and renal function is seen in the advanced cases of obstructive hypertrophy of the prostate. This is very beautifully shown in what I have called the "three phase cycle," which develops when the chronic urinary retention is relieved. A study of the accompanying charts (Figs. 196, 197, and 198) will make this clear. The studies demonstrate that chronic obstruction to the outflow of urine from the bladder, resulting in the constant presence of a large amount of residual urine, has a very marked influence on renal function, and likewise affects all the functional tests. The first phase shows the activity of the kidney very greatly increased, the organ secreting large quantities of urine of a low specific gravity. There is only a trace of albumin in the urine. Functional tests, providing the patient is otherwise in good health, are usually good. The phthalein test may show 60 per cent. to 70 per cent. elimination of the drug in two hours. Or, again, the case may be so far advanced that none of the drug is excreted in the first two hours. In other words, none of the so-called functional tests gives us any exact knowledge of the true renal sufficiency. Why? *Because the true functional power of the organ is obscured by the additional burden of obstruction which hampers its work.* Remove the obstruction and a reactionary phase appears; the tension is suddenly relieved, and the kidney function is again perverted, having the sudden change in the prerenal system to adjust itself to, as well as the changes in the local

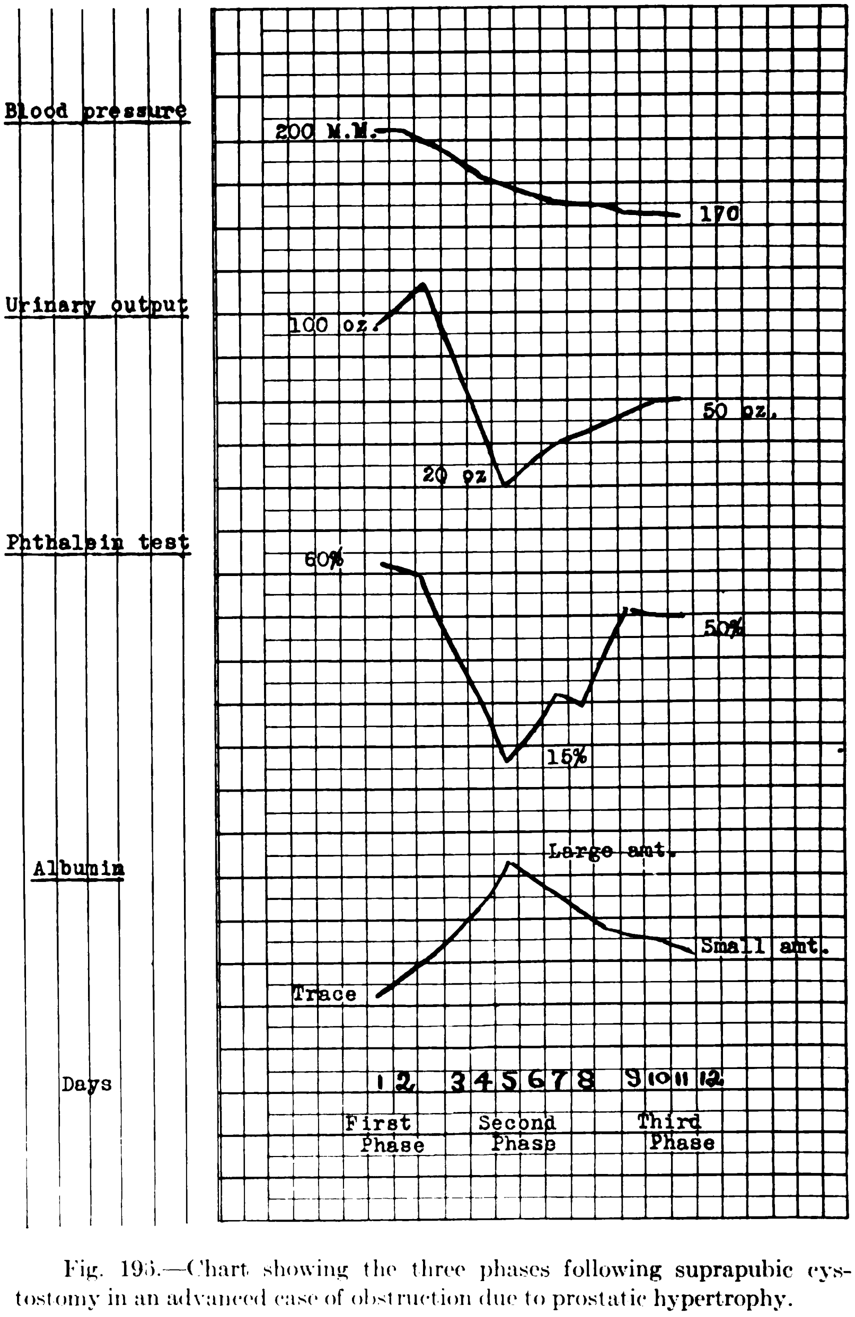


Fig. 195.—Chart showing the three phases following suprapubic cystostomy in an advanced case of obstruction due to prostatic hypertrophy.

First phase: Includes the first and second day, the suprapubic cystostomy nervous and vascular system (relief of the distended pelvis, congestion of the kidney, reflex nervous stimuli, etc.). Apply your functional tests now, and the next forty-eight hours will show the index of efficiency to have dropped far below that which was found when the obstruction was unrelieved. In other words, we have made our tests under distinctly different anatomic conditions, and while both results are instructive, *neither shows the true functional sufficiency of the kidney.* A week later, following the relief of the urinary obstruction, after the appetite has returned and the patient's physical condition has improved, make a third test. The index of efficiency will be found much higher

being done on the first day. If one would observe this chart excluding the following days, the conditions would seem to be favorable for any operative encroachment. (See page 295.) If taken alone, this surely would seem to indicate a safe surgical risk.

Second phase: This phase extends over the third, fourth, fifth, and sixth day after a suprapubic cystostomy. It shows a very marked decrease in urinary output during that time, a large increase in the amount of albumin present, but, most important of all, the drop in functional capacity of the kidney from 60 to 15 per cent.

Third phase: Showing the reaction and the recovery of the kidney after ten days. Blood-pressure, 170; urinary output averaging 50; phthalein test, 50 per cent., and a smaller amount of albumin present in the urine. Comparing this phase with the first phase, we find a lower blood-pressure, a normal urinary secretion with an increased specific gravity, a lowered functional capacity of the kidney, as attested by the phenolphthalein test, and a larger amount of albumin present in the urine than during the first phase. When, however, the reaction from this phase following enucleation of the prostate is considered, what a much better combination of circumstances exists in this phase than in the first phase! Following prostatectomy, the blood-pressure falls still lower, due to the loss of blood. The urinary output decreases most markedly during the first twenty-four hours, but recovers rapidly until, on the third day, it is practically normal. The phthalein test shows lessened reaction, but it never drops as low as was found in the second phase after suprapubic cystostomy, so that 50 per cent., according to the phthalein test in the third phase, shows a very much greater relative functional capacity than 60 per cent. in the first phase. This we consider a point of very great importance. The amount of albumin following the operation is an unknown quantity.

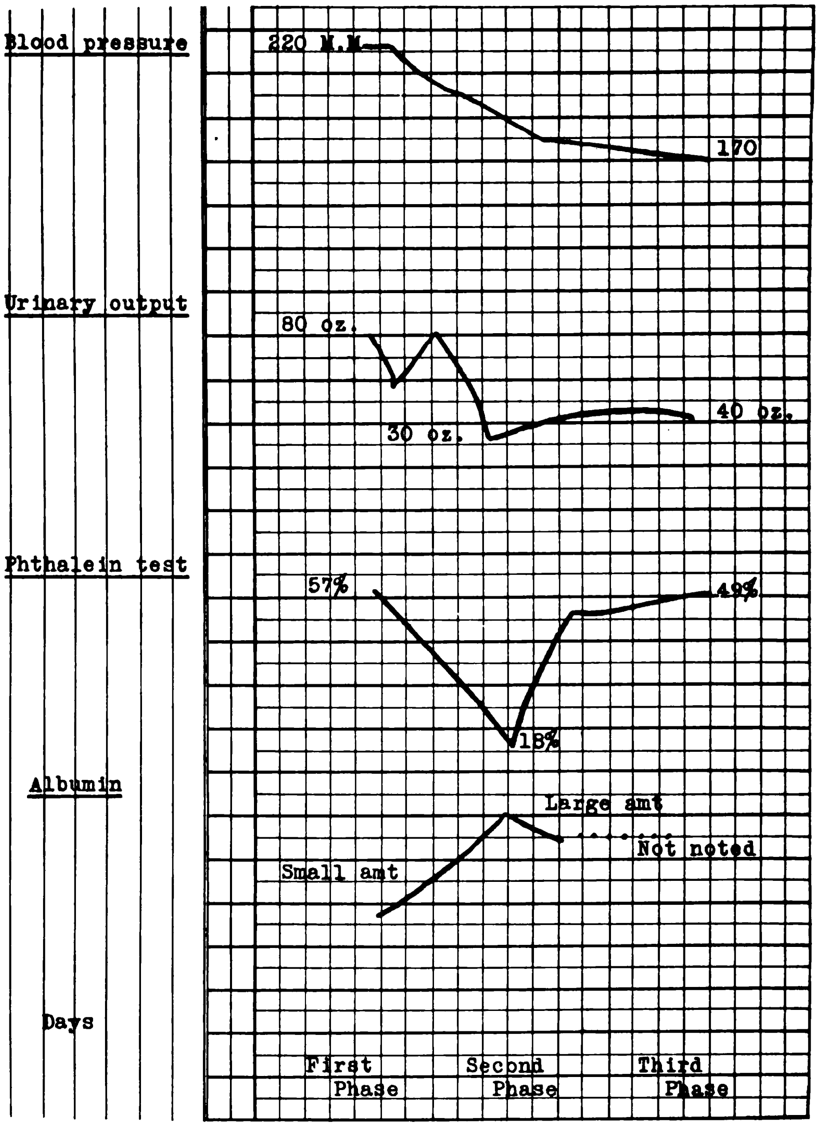


Fig. 197.—A study in renal efficiency and stability showing the three phases in a patient eighty-two years of age. Note the marked difference between the three phases, especially the drop from 57 per cent. to 18 per cent. in the renal efficiency and the large increase in the amount of albumin. Prostate enucleated during the third phase. Complete recovery.

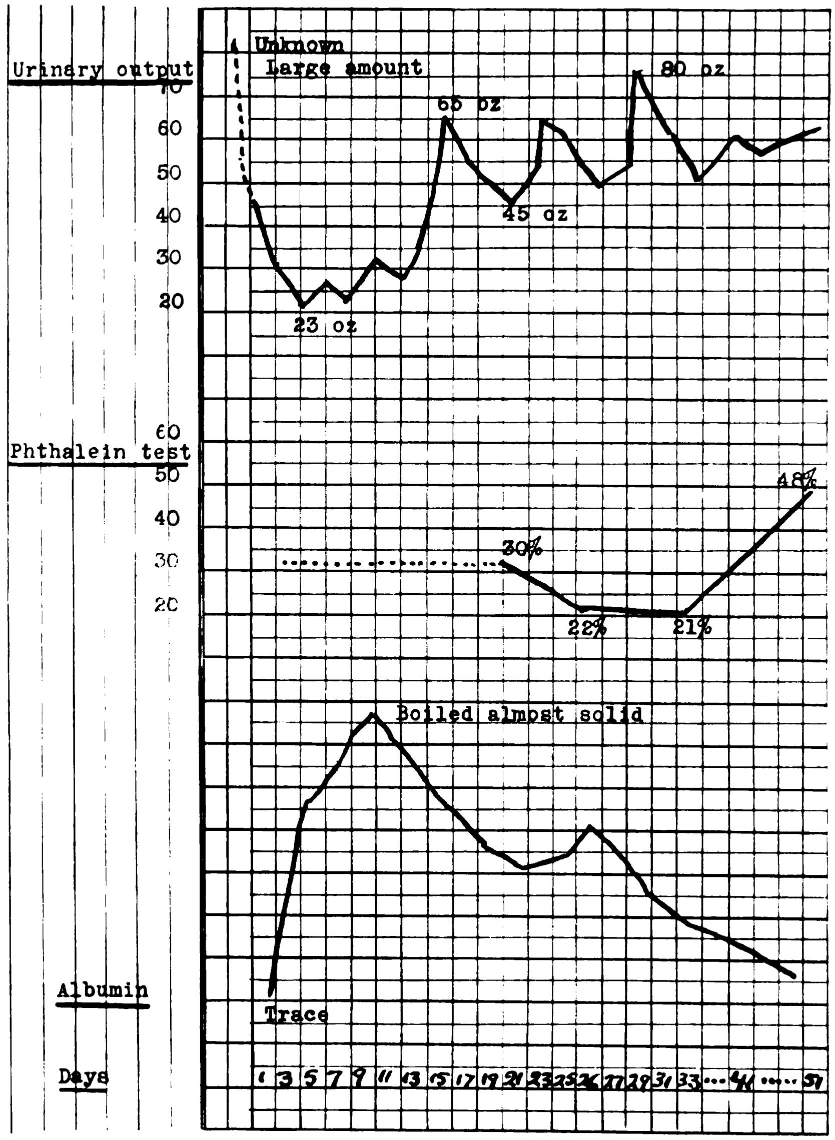


Fig. 198.—A study of renal efficiency and stability, showing the three phases, with a prolonged second stage.

First phase: Aside from the large amount of urine passed, the patient's condition was almost ideal.

Second phase, which followed the suprapubic cystostomy, was unusually severe. Marked diminution in the amount of urine. Urine boiled almost solid. Gastric uremia supervened. Enormous swelling of the legs. Patient in desperate condition. At the end of fifty-one days, however, all the uremic symptoms had disappeared. Amount of urine passed was normal.

Third phase: At end of fifty days phthalein test showed 48 per cent. Urine showed very small amount of albumin. Patient's general condition satisfactory. Prostate enucleated with hardly any postoperative reaction. Patient made perfect recovery.

than at the previous test (in the second or reactionary phase), and this last test will show the true index which we seek, while a chart of the previous test will show us, to a certain degree, the stability of the renal sufficiency. This would indicate that there are two factors which we wish to know concerning the kidney function, *i. e., the index of efficiency and the stability of the renal sufficiency.*

Other examples might be given, showing the variation of the functional index due to stone in the pelvis of the kidney. Cases in which the kidney parenchyma is not much changed may show a low index of efficiency when the functional tests are made. Remove the stone from the pelvis and the index will rapidly return to normal.

Reflex polyuria or oliguria affects the amount, color, transparency, and specific gravity of the urine secreted. The writer has often observed that in the presence of an advanced disease of one kidney the second kidney becomes congested and hypertrophied, and the resulting increase in the number of epithelial cells thrown off is so great that they appear in the urine as a distinct sediment which macroscopically looks like pus and is often mistaken for it, but when examined carefully under a microscope is found to be simply a collection of renal epithelial cells. This would materially alter the opinion formerly held that the extent of the disease of a kidney may be judged by the number and character of the renal epithelial cells found in the urine. As to the urea determination, the wide variation found in normal individuals with perfectly healthy kidneys, the frequent existence of reflex polyuria, and the possibility of the urine escaping beside the catheter, make this test very uncertain. Estimations of the amount of sodium chlorid and of phosphates contained in the urine are misleading because they are so unstable and are affected by so many other conditions of the body. As to the presence or absence of albumin, it has been found that the secretions from a diseased kidney may be entirely free from albumin. Also, that in the presence of a diseased kidney the second kidney may show the presence of albumin in the urine which, after the removal of the diseased kidney, entirely disappears. Oftentimes it is simply a toxic albuminuria.

In other words, the bearing of these introductory remarks is to emphasize the fact that mathematics cannot be applied in the determination of renal sufficiency; that the older methods of diagnosis are not sufficient; that there are forces at work outside of the kidney which have a marked influence on its function; and, lastly, in determining the function of any kidney, it must be remembered that there are two factors to be determined:

1. *The excretory efficiency of the kidney.*
2. *The stability of renal sufficiency.*

RENAL FUNCTION

At the present writing three tests seem to be accepted by the majority of observers as the most reliable. They are blood cryoscopy, the phthalein test, and the carmin test. It is conceded that no one test is infallible and that each has some advantage in certain cases over the others. From the standpoint of ultimate prognosis in a given case it seems logical that blood cryoscopy will offer us very definite information. At the same time no test of this type should be relied upon solely to the exclusion of other clinical data and cystoscopic findings. It must also be properly weighed with a knowledge of the influence of urinary obstruction on the renal efficiency. Taken as an index, for example, in a case of advanced prostatic obstruction, it will show a marked increase in the molecular concentration of the blood. At the same time the phthalein test may show a relatively high percentage of excretion of the drug. In the second phase of the cycle after the obstruction has been relieved the molecular concentration in the blood will decrease, *i. e.*, show an improvement, while the phthalein test will show a decreased renal efficiency. The two tests seem to contradict each other, and yet, to the experienced observer, they present important relative information. On the other hand, when the disease is bilateral, as in cases of chronic interstitial nephritis, no test can give us greater prognostic data than blood cryoscopy, while the phthalein and carmin tests are more uncertain. All tests must be considered relative and not absolute.

Chromo-ureteroscopy, based on the employment of indigo-carmin, is a valuable test of renal sufficiency. It is especially valuable in those cases where ureter catheterism cannot be done. When made by an experienced observer, it gives valuable information as to the relative function of the two kidneys.

Cryoscopy of the blood is a valuable test for the estimation of absolute or total renal function, especially when estimation of relative function, through ureter catheterism, is not feasible.

The phthalein test is simpler and more accurate than any other test of renal function at present in use. *It is useful for the determination of both the efficiency and the sta-*

bility of the excretory functions. This applies more especially to the infections and surgical conditions of the kidney. It probably is not as accurate as blood cryoscopy in determining the prognosis of chronic nephritis. It is more reliable and simpler than the carmin test in estimating the total function of the kidneys.

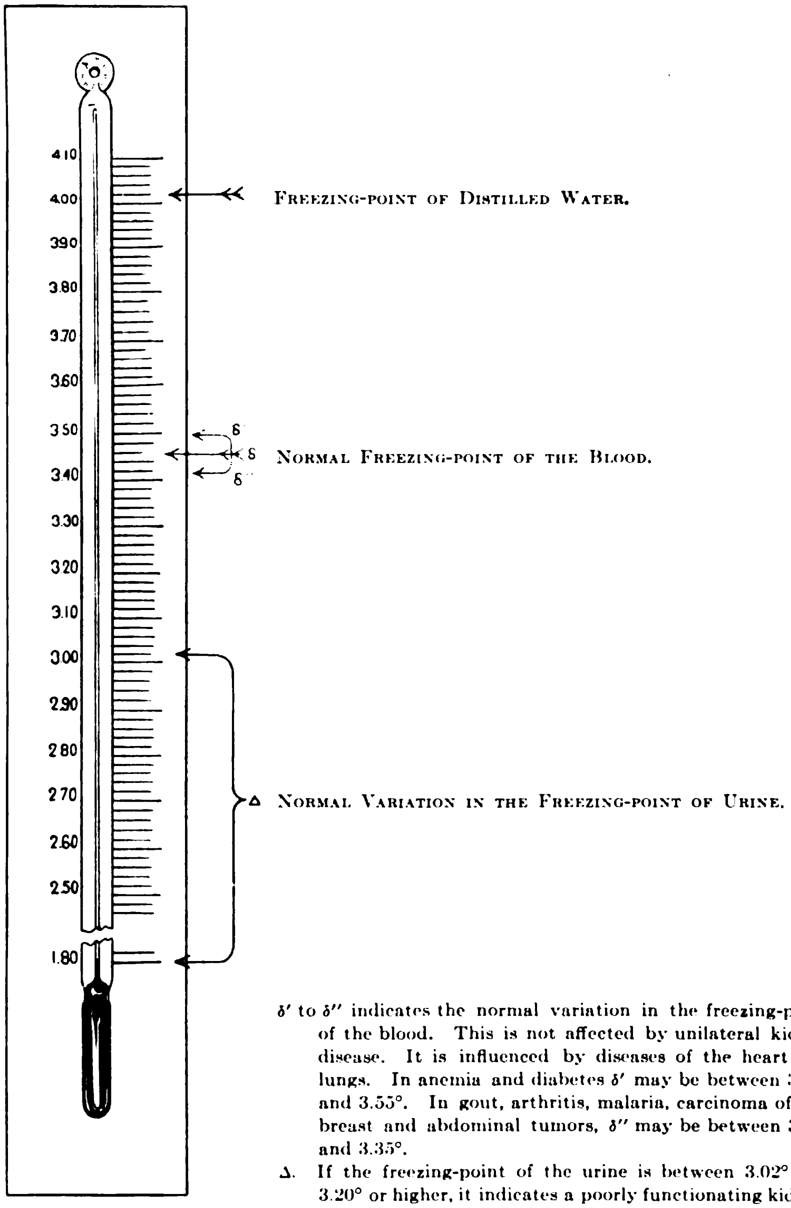
In addition to the above-mentioned tests we sometimes employ the phloridzin test, the production of experimental polyuria, and methylene-blue.

There are also a number of other products which are excreted by the kidneys which have been used as indices of the functional capacity, but most of these have been discarded as not being exact enough for practical use.

The first fact to be established as a result of these investigations was that each kidney possessed a distinct reaction of its own, and the second fact that, in general, all of the methods gave valuable information in cases where there was severe or advanced disease of the kidneys. In the cases, however, where there was only a slight lesion, the results showed considerable variance. For example, where the lesion was slight, or did not involve much kidney tissue, an injection of phloridzin would often show very little variation from the normal, the sugar appearing in the urine twenty minutes after the injection of the drug; at the same time, in the same kidney, the excretion of indigo-carmin would be much delayed. This discrepancy is explained by the supposition that the production of the sugar and the excretion of indigo-carmin take place in different parts of the kidney and are influenced by the extent of the kidney lesion. The third fact to be established was that a kidney may be extensively diseased and still perform its functions.

The five methods which demand serious consideration are cryoscopy, chromocystoscopy, the phloridzin test, the production of experimental polyuria, and the phenolsulphonephthalein test.

Cryoscopy.—Despite the great amount of work which has been done in determining the cryoscopic index of the blood and urine, the results gained from these experiments have not been sufficiently constant to recommend the general adoption of the test. Reference has already been made to its relative value. At first the freezing-point of the urine was thought to be of great prognostic value. Casper found that in cases of kidney disease there was an abnormally low molecular concentration of the urine. This was demonstrated by finding the freezing-point of the urine. Rupel also demonstrated that the lower the freezing-point of the urine, the greater was the extent of the pathologic change of the kidney tissue. Kapsammer claims that if we have a reflex polyuria occurring in a healthy kidney, the freezing-point of the urine is lowered, while at the same time in the urine of the diseased kidney in which the polyuria does not take place, the freezing-point is higher. In order to determine the functionating capacity, the amount of urine which comes from the kidney must be measured during a certain period of time. If, for example, the kidney secreted five ounces of urine in half an hour due to reflex nervous causes, it would be unfair to determine the freezing-point of this urine and estimate the functionating capacity of the kidney thereby; if, on the other hand, only a few drams of the urine were secreted


4.10
4.00
3.90
3.80
3.70
3.60
3.50
3.40
3.30
3.20
3.10
3.00
2.90
2.80
2.70
2.60
2.50
1.80
Freezing-point of Distilled Water.
δ'
δ
δ''
Normal Freezing-point of the Blood.
Δ
Normal Variation in the Freezing-point of Urine.

δ' to δ'' indicates the normal variation in the freezing-point of the blood. This is not affected by unilateral kidney disease. It is influenced by diseases of the heart and lungs. In anemia and diabetes δ' may be between 3.50° and 3.55°. In gout, arthritis, malaria, carcinoma of the breast and abdominal tumors, δ'' may be between 3.42° and 3.35°.

Δ. If the freezing-point of the urine is between 3.02° and 3.20° or higher, it indicates a poorly functionating kidney.

Fig. 199.—Diagram and illustration of points in cryoscopy.

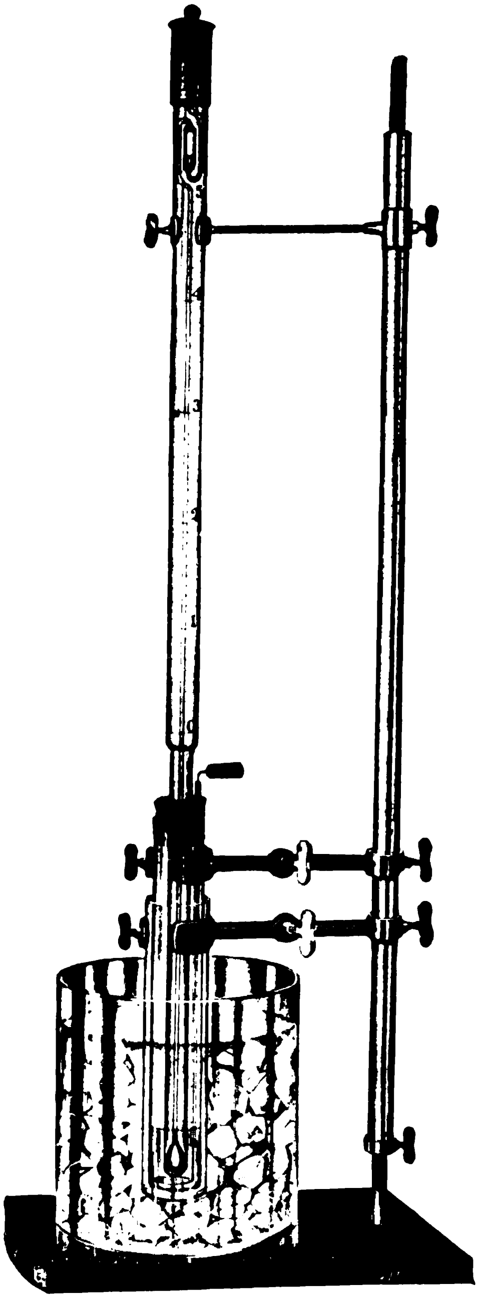


Fig. 200.—Arrangement of apparatus for making cryoscopic test of the urine and blood (Fowler).

in the first half hour, the determination of the freezing-point of this fluid would be worthless. It is expected that those who are trying the test will use common sense in its application and then it will be of value. Blood cryoscopy is infinitely more valuable than urine cryoscopy, inasmuch as it can be applied without disturbing the urinary apparatus in any way. It is of value only for the determination of the total existing renal function. In parenchymatous nephritis, special care is necessary in interpreting the results. Our object is to determine the true functional activity of the kidney and to learn, if possible, whether the degree of anatomic destruction of the second kidney and its consequent physical disturbances allow of removal of the first kidney.

Technic.—The apparatus consists of a glass jar which is filled with a freezing mixture of salt and ice. Into this is placed a small glass cylinder pressed down into the freezing mixture. Inside of this glass cylinder is a second glass cylinder a little smaller and with a flat bottom, into which the fluid to be tested is poured. In this inner tube is suspended a Beckmann thermometer, graduated in fractions of a degree, and a platinum wire is also suspended in the tube to be used for stirring the solution, in order that the fluid may be of an equal temperature throughout. The contents of the inner tube are separated from the freezing mixture by an air space. Ten to 20 c.c. of distilled water are first placed in the inner glass cylinder in sufficient quantity to cover the bulb of the thermometer. The fluid cools slowly, being constantly stirred. The mercury in the thermometer rapidly falls below the freezing-point; then it stops and suddenly jumps up, reaching a high point, where it rests momentarily; this is the freezing-point of the fluid. This point must be noted, for in a few minutes the mercury falls slowly to the temperature of the freezing mixture. If no decided jump in the mercury occurs, the technic has been improperly carried out or the fluid has not been properly stirred. The bulb of the thermometer must not touch anything or it will affect the test. After the freezing-point of distilled water has been determined, the water is poured out, and the fluid, either blood or urine, is taken and introduced into the inner cylinder. This is, in like manner, stirred slowly, the sudden jump in the mercury to its highest point noted, and the difference between this point and that already reached by distilled water will be the index of its molecular concentration. For example, if the freezing-point of distilled water under the circumstances existing at the time of the experiment, using a Beckmann thermometer, is 4.02° C., and the freezing-point of the blood registers 3.46° C., the difference between these two will be 0.56° C.; that is, the freezing-point of the blood is 0.56° C. below that of distilled water, which is the normal index (Fig. 199).

It was found by Korányi that in normal individuals, the freezing-point of the blood averages 0.56° C. below that of distilled water. He further determined that in health this varied less than 0.01 of a degree. Also, that when the kidneys were not functionating properly the freezing-point of the blood was lower than —0.56° C. compared with that of distilled water.

In estimating the functional capacity of the kidneys, many observers have decided that the cryoscopic index of the blood is more valuable than that of the urine, and, furthermore, that when both are determined, it will afford the most valuable information. Kummell states that when the freezing-point of the blood is more than —0.60° C., it indicates a renal insufficiency and nephrectomy is contraindicated.

Conditions which Influence the Test.—The test is influenced by the presence of abdominal tumors, renal colic, renal stones, and pregnancy. In a weak and anemic person the freezing-point may increase to —0.53° C. without indicating severe kidney lesion. Lowering of the freezing-point of the blood indicates that the kidneys are insufficient, the lowest limit being —0.60° C. When the kidneys are normal, the freezing-point of the blood is —0.56° C. (Fig. 199).

The freezing-point of the urine varies. Normally, it varies between 0.9° C. and 2.9° C. below the freezing-point of distilled water. Kummell considered that if the freezing-point is less than 0.9° C. below that of distilled water, the kidney function is insufficient. Even those who are most enthusiastic over this method do not depend upon it entirely in forming their judgment of the functional activity of the kidney.

Electrical Conductivity of the Urine.—Estimation of the electrical conductivity of the urine is always a complicated procedure and does not tell any more than cryoscopy, so space will not be taken up here to describe it.

The Phloridzin Test.—This test depends upon the production of a temporary glycosuria by the hypodermatic injection of 0.01 gram of phloridzin. It has been definitely determined that the conversion of the glucosid takes place in the kidney, but no one has as yet been able to demonstrate conclusively whether this takes place in the tubules or the glomeruli.

Technic.—A fresh watery solution is used; this is sterilized immediately before injecting by bringing the solution to a boil, removing it from the heat just as it reaches the boiling-point. The solution is then drawn up into a hypodermatic syringe directly from the receptacle in which it has been sterilized, and is injected warm. It is important to carry out the method in this way or the phloridzin will stick to the sides of the receptacle and only distilled water will be injected. One c.c. of a freshly boiled 1 per cent.

aqueous solution is injected (phloridzin, 0.5; aquæ dest., 50.0). An alcoholic solution of phloridzin may also be used for the injection. It has been found that in advanced lesions of the kidney the sugar production, after the injection of phloridzin, is disturbed. Casper and Richter, working on this hypothesis, found that the functionating capacity of the kidney could be determined by finding the percentage of sugar excreted by the kidney. Kapsammer found that, in general, a diseased kidney worked slower than a sound one, and is teaching that the best proof of functional activity of the kidneys depends upon the time of the appearance of the sugar in the urine after the exhibition of phloridzin. Ten minutes after the injection of phloridzin the urine is examined, and then every five minutes thereafter. A healthy kidney should first show a sugar reaction ten or fifteen minutes after the injection. This would show a normal functional activity of at least a portion of the kidney. If the sugar reaction does not appear for thirty minutes, there is probably some disturbance in the functional capacity and nephrectomy should be undertaken with caution. The more advanced the anatomic destruction of parenchyma of the kidney, just so much later will the sugar reaction appear. It is best to use a small amount of phloridzin, as the test is more delicate and there is no chance of causing any injury to the kidney. When the method of Casper is used, that is, the determination of the exact amount of sugar secreted by each kidney, a careful quantitative test must be carried out; the urine is collected separately from each kidney, and then the quantity of sugar in each is determined. This method has not proven itself more valuable than the determination of the time of the appearance of sugar in the urine, as advocated by Kapsammer, in which each urine is collected separately and subjected to the Fehling test every five minutes.

It is important to remember that almost always in the presence of a diseased kidney the remaining kidney is congested, and its normal function is somewhat perverted. This must be taken into account in weighing the evidence.

Example of Phloridzin Test

CASE: Tuberculosis of left kidney.

URINE FROM LEFT KIDNEY	URINE FROM RIGHT KIDNEY
Light-colored urine	Amber-colored urine
Acid reaction	Acid reaction
Specific gravity: 1008	Specific gravity: 1020
Albumin: Trace	Trace of albumin
No sugar reaction after thirty minutes following injection of phloridzin	Sugar reaction after twenty minutes
Moderate number of pus-cells	No pus-cells
	Numerous granular renal epithelia
Few tubercle bacilli	No tubercle bacilli
Few red blood-cells	Few blood-cells

The Indigo-Carmin Test (*Carminum Cœruleum*).—This test consists of a hypodermatic injection of indigo-carmin dissolved in normal salt solution. It is injected preferably into the gluteal muscle.

Technic.—1. The patient is placed in position as for any cystoscopic examination.

2. Then 20 c.c. of a 0.4 per cent. solution of indigo-carmin, warmed to blood heat, is injected deeply and slowly

into the gluteal muscle. Some operators use preliminary local anesthesia.

3. The bladder is thoroughly cleansed and 200 c.c. of sterile boric solution is introduced. This must be perfectly clear.

4. The anatomy of the bladder is then carefully studied, especially noting the conformation, effluent, and situation of the ureter opening.

5. Maintenance of brilliant illumination (B. A. Thomas*), while watching the ureter openings for the first appearance of the dye.

6. Noting the time of appearance of the dye and the intensity of color.

If the elimination is first observed as a light blue or greenish coloration, instead of the usual dark blue, the observer should note whether the color becomes intensified during the next thirty minutes. The renal sufficiency must be judged chiefly from a combined observation of the *time of appearance* and the *intensity of the color*. The duration and quantity of excretion are not important.

Kapsammer believes that the length of the interval between the injection of the indigo-carmin and the appearance of the blue color in the urine is of the greatest importance.

Usually in normal cases the drug appears within from three to fifteen minutes on both sides at the same time.

The conclusions of Thomas in an analytic study of 200 cases is as follows:

1. Indigo-carmin is eliminated from functionally sufficient kidneys as a dark blue in from three to twenty minutes, and as a light blue not later than fifteen minutes.

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* Thomas: *Jour. Amer. Med. Assoc.*, vol. lx, p. 185.

In 90.1 per cent. of kidneys it appears either as a dark or light blue in fifteen minutes; in 61.1 per cent. it is observed in ten minutes.

2. If the indigo does not appear at the expiration of fifteen minutes (light blue) or twenty minutes (dark blue), it is evidence of serious insufficiency of the renal function.

3. If the elimination of the dye does not occur at all, the respective kidney or ureter is gravely diseased.

4. The intensity of the color reaction depends to some extent on the concentration of the urine, but largely on the individual excretory power of the organ.

5. A surgically diseased kidney eliminates the dye less intensely than its normal twin organ, or not at all.

6. The test is very simple, and by alternate observations of the two ureteral orifices differences between the two kidneys are readily, accurately, and speedily noted.

The Phenolsulphonephthalein* Test.—This is one of the most delicate tests we have for estimating the functional activity of the kidneys. Six milligrams of phenolsulphonephthalein is added to 1 c.c. of normal salt solution; the solution is sterilized by boiling and is injected hypodermatically. It is useful either to determine the combined function of the kidneys or for estimating the relative or comparative renal functions.

Technic.—Twenty minutes to half an hour before the test the patient should be given one or two glasses of water to drink. One cubic centimeter of phenolsulphonephthalein solution, containing 6 mg. to the cubic centimeter, is injected.

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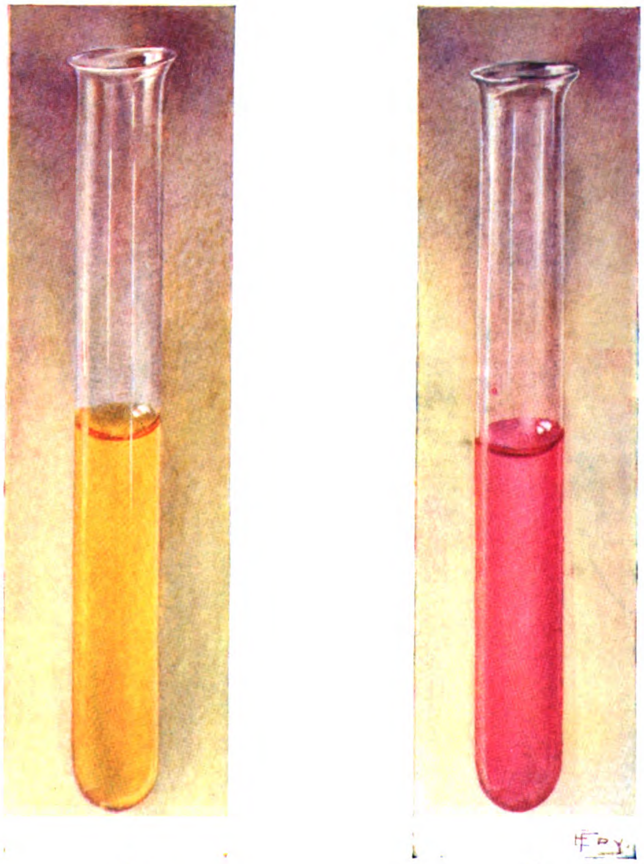
* For the preparation of this drug, and a more extended discussion of the technic, and results of its use, see article by Rowntree and Geraghty, "Jour. Pharmacology and Experimental Therapeutics," vol. i, No. 6, July, 1910.

If the *combined function* is to be determined, the injection is made hypodermatically into the lumbar or gluteal region. If the test is made to estimate the *comparative renal function*, *i. e.*, by the use of the ureter catheter, the injection may be either intravenous or into the muscle.

For *total function* 1 c.c. of phthalein solution (6 mg.) is injected into the lumbar muscles. The patient should empty his bladder after an interval of one hour and ten minutes. If there is retention of urine, a catheter should be used. The extra ten minutes is added because the average time of appearance in the urine is ten minutes. This specimen is tested, and the total quantity of phthalein excreted is estimated. The second specimen is collected at the end of two hours and ten minutes. The percentage of phthalein contained in this specimen is also estimated.

For Separate Function of Each Kidney.—First, the ureters are catheterized. Do not inject the phthalein until the urine begins to flow normally from the ureter catheters. When the normal flow is established (if this takes place), the phthalein is injected either intravenously or intramuscularly. If the injection is made into the vein, the drug will appear in the urine about two minutes sooner than otherwise, and a larger percentage will be excreted during the first hour. The observer must establish a totally different index for judging between the two methods. By preference the intravenous method is used. The urine is collected in two fifteen-minute periods, beginning the collection with the first appearance of the drug from either kidney. To detect the first appearance of the drug about 2 c.c. of 25

PLATE IX



A B

THE PHENOLSULPHONEPHTHALEIN TEST.

A, Test-tube containing urine coming from the kidney twelve minutes after phenolsulphonephthalein has been administered. The color is canary-yellow when the urine is acid. B, Shows the same solution after the addition of an alkali.

per cent. NaOH is placed in a test-tube, and the urine dropping from the catheter is allowed to fall into the alkaline solution. As the first trace of the drug appears in the urine, a faint pinkish color will disseminate itself through the alkaline solution. There is no mistaking its appearance, and it can be detected in a single drop of urine. As the amount in the urine increases the color becomes more intense. In an acid urine the color is a deep yellow. In a strongly alkaline solution the color is pink to carmin, as in the accompanying illustration (Plate IX).

If we only wish to determine whether a non-diseased kidney is capable of carrying on the total renal functions, the urine collected in one fifteen-minute period will usually be sufficient. If we are making a comparison of two diseased kidneys, or are estimating the relative function of each for purposes of diagnosis by comparative tests, longer periods are better. It should be emphasized that in every case where the renal function has been tested by the aid of the ureter catheter a combined or total functional test should be made at a later period, to act as a check on the first examination. It sometimes happens that ureter catheterism has a marked inhibiting effect upon the renal functions, thereby vitiating the tests. In such cases the carmin test is especially valuable.

Following intramuscular injection of phthalein the drug should appear in the urine in less than twelve minutes if the renal function is efficient. From 40 to 60 per cent. of the drug is excreted in the first hour, and then about 10 to 15 per cent. in the second hour. It does not appear in the stools even when administered by the mouth, and seems to be entirely excreted by the kidneys. The test is interfered with by parenchymatous nephritis, but does not seem to be influenced by chronic interstitial nephritis. It is well to give plenty of water before the injection.

Estimating the Percentage of Phthalein Excreted.—The Duboscq colorimeter, or the modified Hellige colorimeter, may be used. The operator may establish his own standard by adding 3 mg. of phenolsulphonephthalein to 1000 c.c. of distilled water which has been rendered thoroughly alkaline, then filling a series of test-tubes with different strengths of this solution, establishing a color scale representing various percentages of the drug present in each test-tube; then, taking all the urine excreted during the first period, diluting the same to 1000 c.c. with distilled water (after adding NaOH until there is no more deepening of the color), pouring a portion of this into a test-tube, and comparing it with the scale (Cabot). The other methods employ instruments which give a more exact reading, instructions for their use coming with each instrument. The method has been extensively used by Geraghty.* If necessary, the patient's urine may be used to make up a standard color scale.

Application of the Test.—In estimating the total renal function, the total quantity excreted in the first and second hour is taken as the best index of efficiency. If the kidney is normal or functionally sufficient, it should excrete between 40 per cent. to 60 per cent. or 65 per cent. of the drug in the first hour, and from 10 per cent. to 15 per cent. or 20 per cent. in the second hour. Under excitement of the manipulations the onset of the excretion or the full capacity for excretion may be delayed and practically equal amounts be excreted in the two-hour periods, but we have found that at least 50 per cent. of the drug should be excreted in the first two hours, or else the renal function must be considered below par. However, we must always remember that the renal function depends on both the prerenal and postrenal factors, as previously stated. Therefore, in certain cases, *i. e.*, stone in the kidney, obstructive prostatic disease, cardiac failure, etc., the test must be considered only relative. Again, the stability of the renal function is a very important factor to establish, for we have found that in certain cases where the phthalein output was persistently low, yet at certain periods the patient could be safely operated upon. This is especially true in prostate cases, and cases of advanced disease of one kidney whose presence is constantly embarrassing the work of the other, whose phthalein index is constantly below par. Yet in both instances the patients have reached a state of renal stability which is not much disturbed by operation.

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* Rowntree and Geraghty: "Jour. of Pharmacology and Experimental Therapeutics," vol. i, No. 6, July, 1910.

When only a trace of the drug is found, operation is absolutely contraindicated. When time of appearance is beyond half an hour, or the total amount excreted is below 40 per cent. for the two hours, operation should be postponed until further tests have been made. One must always remember that the usual chemical and microscopic tests, including the urea estimation, are absolutely essential.

Comparative Test of the Two Kidneys.—We consider that both the time of appearance and the total quantity excreted are of importance in connection with ureter catheterism. Each is dependent to a certain extent on the other. There is always the possible source of error which occurs from delayed function on either side, plugging of the catheter, leakage along the outside of the catheter into the bladder, or other causes. Only comparative or relative renal function should be determined by ureter catheterism.

Value of the Test.—After using the test in a large series of cases under varying conditions, we consider it the simplest, most delicate, and withal the most practical test to use as an adjunct to the other clinical and laboratory methods available, in judging both the excretory efficiency of the kidney and the stability of the renal sufficiency.

The chief advantages claimed by Rowntree and Geraghty are:

(1) The complete elimination of the drug by the kidneys, its chemical nature being unchanged.

(2) The early appearance of the drug in the urine following its administration.

(3) The rapid excretion of the drug by the kidneys, necessitating observation over only a short time—one or two hours.

(4) The brilliancy of color which is imparted to alkaline urine and which is not readily influenced by the coloring-matter of the urine itself.

(5) The facility with which this drug lends itself to colorimetric methods, making accurate quantitative estimations possible.

(6) The simplicity of the technic for quantitative estimation.

(7) The absolute non-toxicity of the drug.

(8) The non-irritant nature of the drug locally.

(9) The extreme smallness of the dose required and the

assurance this gives of there being no extra strain placed upon the kidney during the test.

Experimental Polyuria.—Albarran was the first to try the effect of producing a temporary polyuria, estimating the functional activity of the kidneys in proportion to the increase of the quantity and quality of the urine secreted. This takes into account the total amount of urea or nitrogen excreted, the freezing-point of the urine, and the microscopic examination of the urine.

Technic.—The patient should not be given anything to eat or drink for a number of hours before the experiment is to be performed. Then the patient is given 400 to 500 c.c., or about one pint, of mineral water to drink. Both ureters are catheterized and the urine collected for half an hour, and the amount of urine secreted, its molecular concentration, the amount of urea, the percentage of sodium chlorid, and its absolute quantity estimated; at the same time the amount of sugar excreted after the injection of phloridzin is determined. The first urine taken is examined microscopically. Then three specimens are examined consecutively at the end of half an hour, one hour, and an hour and a half. As a rule, with a normal kidney, the amount of the urine begins to increase in the first half hour and reaches its highest point at the end of the third half hour. At the end of the fourth half hour it drops to the point from which it started. At the same time the quality of the urine deteriorates, the percentage of the urea present diminishes, and the freezing-point of the urine approaches nearer to that of distilled water, this change being in proportion to the intensity of the polyuria. The actual work done by the kidneys is increased. The diseased kidney, on the other hand, shows very little variation under the changing conditions, the output being constant. This demonstrates that a normal kidney has a wide range of function and is able to accommodate itself to circumstances, while a diseased kidney is very much limited and is not able to meet any increased demand. Guyon and Albarran showed that the kidney, when it was in a state of advanced disease, had practically a constant output of urea and water during the twenty-four hours, while that from a normal kidney varied constantly. Keyes has shown this in a series of charts. If both kidneys are normal, the charted curves may be expected to run parallel, although if the same two kidneys are examined at a subsequent period, their parallel curves may be entirely different. If the percentage of urea varies only a little, or even increases during the test, one must consider the polyuria at least relatively ineffectual. It must also be remembered that frequently urine escapes beside the catheter into the bladder, so that the amount collected may not be the real amount secreted, and naturally would give a false impression of the test. Also, the production of a reflex polyuria is so frequent that it must always influence our judgment. The results of the experiment show that the amount of urine is increased and the percentage of urea is decreased when the kidney is normal. Sometimes, according to Keyes, the quantity of urine does not increase, but the percentage of urea does.

When a grave toxemia exists, there is a decided effect upon the normal kidney.

The efficiency of the polyuria may be estimated by the decrease in the percentage of the urea, especially during the third half hour. If the kidney is diseased, the quantity and the quality of the urine change very little. The curve, as charted, shows very little change, but comparing it with that of the normal kidney, we can form some idea of the relative functional activity of the two kidneys. If both kidneys are gravely infected, the test is not of much value. It, however, affords an opportunity for combining several tests in one; that is, we are able to make a microscopic examination of the urine from each kidney separately; we are able to estimate the amount of urea or nitrogen output from each kidney separately, determine the freezing-point of the urine, estimate the effects of the phloridzin injection, and study the effect of experimental polyuria. These, taken together, will give a very valuable index of the functional capacity of the given kidney. The grave objection, however, is the length of time it takes to make the determination.

There are also a large series of substances which have been used in determining the functional capacity of the kidneys, but none of them have proved as important as those already described. Tests for the excretion of potassium iodid, salicylic acid, fuchsin, methylene-blue, and other dyestuffs, present no advantage over those already described. The lactose test has not proved of sufficient value in connection with cystoscopy to be described here.

Diastase and urea percentage are chiefly of value in connection with other tests.

In order to estimate the functional capacity of a kidney, the tests should be conducted in a systematic way, and it will be found that it is possible to form a fairly accurate idea of the functional capacity of the given kidney. The patient should be properly prepared and all drugs withdrawn at least six hours before examination.

In many cases the use of the phthalein test, taken always in connection with the other clinical and laboratory data, will give us all the necessary information concerning the kidney. It must be remembered that even a normal kidney will not stand the shock or septic intoxications following some operations.

Blood cryoscopy always gives reliable information relative to the total renal efficiency.

The advantage of the indigo-carmin test is the fact that the ureter need not be catheterized in order to note the appearance of the blue color in the urine from the given kidney, so that if we have a known disease of one kidney, we can estimate with a certain degree of exactness the functionating capacity of its companion organ by simply making a cystoscopic examination and noting when the blue color of the urine appears at the ureter mouth leading from the supposed normal kidney.

PART VI

DISEASES OF THE KIDNEY

CHAPTER I

HYDRONEPHROSIS

Many diseases of the kidney are accompanied by more or less deformity of the renal pelvis. This includes renal calculus, tumors, tubercular disease, and many of the suppurative lesions of the kidney. A true hydronephrosis, however, is dependent upon other causes, is usually intermittent, and gives rise to definite clinical symptoms.

Etiology.—A true hydronephrosis is always due to a partial obstruction or an intermittent complete obstruction of the ureter. A long-continued complete obstruction does not result in hydronephrosis, but in atrophy of the secreting tissue of the kidney. The causes are both congenital and acquired. The congenital causes are: Partial defects in the development of the ureter, bladder, prostate, or urethra; valve-like formations

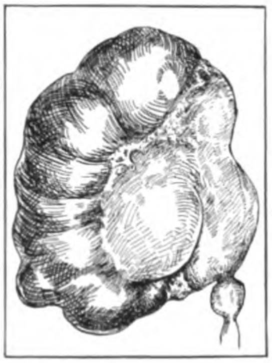
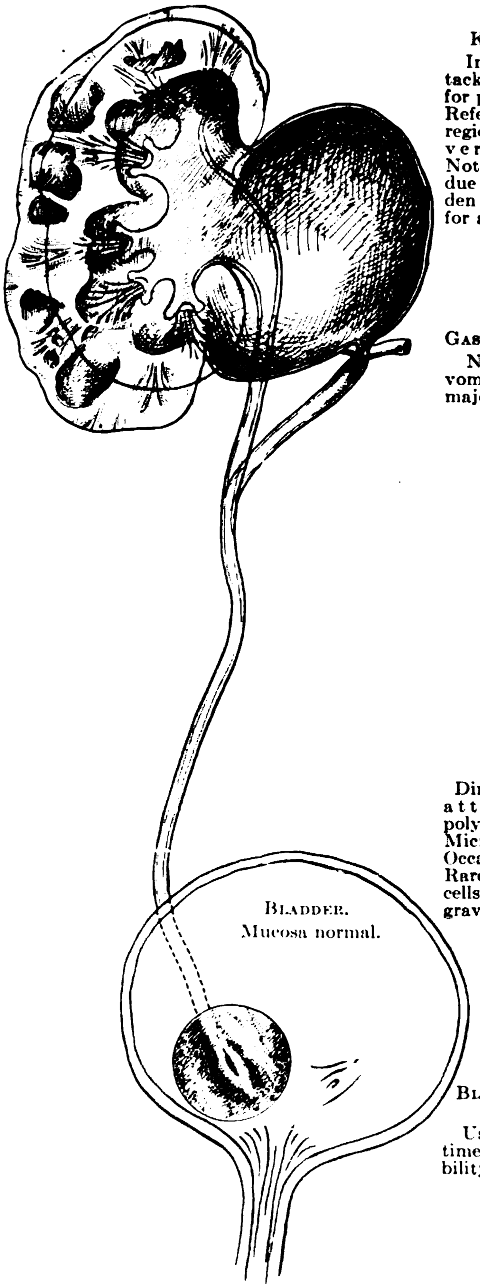


Fig. 201.—Stone obstructing the upper end of the ureter, causing hydronephrosis. (Redrawn from Keyes.)

HYDRONEPHROSIS

TUMOR.
Present in about one-third of cases.



URETER CATHETER.
Smooth, easily passed obstruction 20 to 25 cm. from meatus. Steady drip of urine from catheter after passing obstruction. More than an ounce of residual urine. Urine pale, low specific gravity. Slightly turbid. Few pus-cells.

PELVIC DISTENTION.
Normal, 5 to 15 c.c. In hysterical patients, 30–40 c.c. Pathologic, over 50 c.c.

PHLORIDZIN TEST.
Albarran has shown that it is delayed on both sides.

MEATOSCOPY.
Occasional weak spurt from a relaxed elongated meatus.

KIDNEY PAIN.
Intermittent attacks of acute pain for period of years. Referred to kidney region and costovertebral angle. Not as acute as colic due to stone. Sudden onset. Soreness for a few days.

GASTRIC SYMPTOMS.
Nausea and vomiting at first in majority of cases.

URINE.
Diminished during attacks. Reflex polyuria following. Microscopic pus. Occasional cast. Rarely few blood-cells. Low specific gravity.

BLADDER.
Mucosa normal.

BLADDER SYMPTOMS.
Usually none. At times slight irritability.

Fig. 202.—Plate showing signs and symptoms and cystoscopic appearance of the ureter opening in cases of hydronephrosis.

in the ureter, high implantation of the ureter, anomalous renal blood-vessels crossing the ureter and going to the lower pole of the kidney, causing a constriction of the ureter; and a displaced kidney. The acquired causes are: Inflammatory or traumatic strictures of the ureter, stone impacted in the ureter, tumors pressing on the meatus or compressing the ureter, periureteral inflammatory exudates, bands passing across the ureter, kinks or twists of the ureter, and dilatation of the ureter during pregnancy.

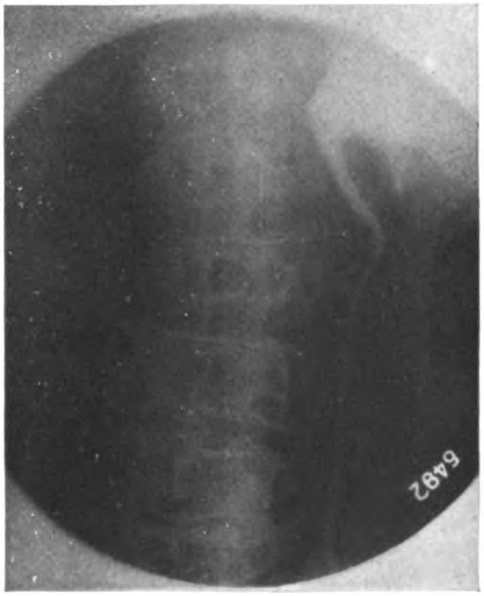


Fig. 203.—Radiograph of normal pelvis and ureter injected with collargol solution. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

In about two-thirds of the cases the obstruction takes place at the ureteropelvic junction.

Subjective Symptoms.—Intermittent hydronephrosis usually occurs in young adults, between the ages of twenty and thirty years, who have suffered for a number of years from indefinite sensations or attacks of pain or discomfort in the region of one or the other kidney. The pain is best described as a unilateral abdominal pain affecting the upper quadrant of the abdomen and passing through to the back in the region of the intercosto-vertebral angle. The pain is not transmitted along the ureter to the bladder, and, as a rule, is not accompanied by increased frequency of urination. It may be felt in the iliac region, but this is dependent on the size and position of the hydronephrotic mass. Gastric symptoms are, as a rule, present, the attack being ushered in by nausea and vomiting which subsides gradually. During the acuteness of the attack there is

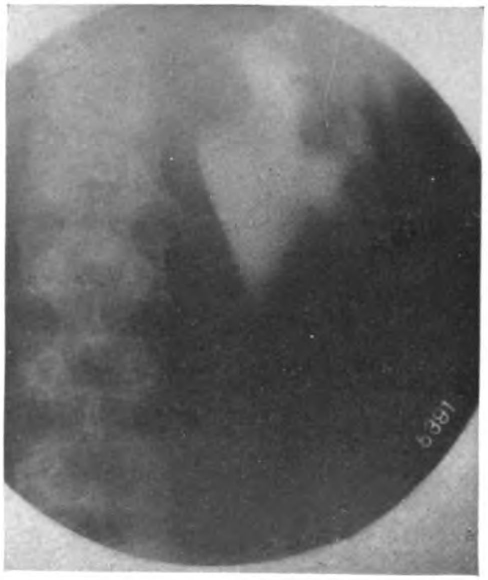


Fig. 204.—Mechanical distention of the renal pelvis in a case of hydronephrosis due to the blocking of the ureter. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

a rise of temperature, usually not above 100° F., with some increase in the pulse-rate.

An attack is usually brought on by exercise and rarely comes on when the patient is reclining. These attacks are intermittent in character, coming on at intervals of weeks, months, or even years. Between the spells there may be present a more or less pronounced ache or dragging sensation in the loin.

The attacks of pain are not as severe as those due to renal calculus, but may be equally as exhausting and may continue for hours. If the obstruction is relieved, all of the pain disappears. Acute pain may be entirely absent and the patient complain only of discomfort and the presence of a tumor in the side.

Palpation.—In the majority of cases no tumor will be palpable, but in many cases enlargement can be definitely made out. During the acuteness of the attack the hydronephrotic mass, as palpated through the abdominal wall, is tense and smooth. All degrees of enlargement are found. By bimanual palpation one can obtain a very fair idea of the size of the tumor. The mass is distinctly tender to the touch, and in some cases is very painful. It is only in the more chronic cases and those with an enormous distention of the pelvis that fluctuation can be felt.

Urination.—As a rule, this is very little disturbed. In many of our cases we fail to see the oft-described, gradual anuria with development of a tumor in the renal region, and then a sudden relief of the pain, disappearance of the tumor, and the voiding of greatly increased quantities of urine. The obstruction is overcome gradually and the pelvis does not empty itself for hours or even days. Again, the quantity of urine contained in the pelvis seldom exceeds four or five ounces at a time, and the drainage of that amount of urine would not very materially increase the output from the bladder. These observations are the result of actual experience in a number of cases checked up by accurate cystoscopic examination and ureter catheterism.

Some patients complain of slight bladder irritability, but this is the exception. *Intermittent hydronephrosis is one of the few acute diseases affecting the kidney which is not accompanied by increased frequency of urination.**

Polyuria may follow the attack, but it is due to reflex nervous disturbances rather than to the sudden evacuation of a hydronephrotic sac.

Urine.—The urine from the diseased kidney is usually cloudy, slightly alkaline, of unpleasant odor, variable specific gravity, and almost without exception contains pus-cells. The character of the urine and the number of pus-cells contained depend largely on the amount of drainage which is taking place. An examination of the combined urines is often misleading, for pus-cells may be found in the urine coming from one kidney, whereas an examination of the combined urine will not show any.

Functional Tests.—There seems to be a peculiar influence exerted upon both kidneys in the presence of a hydronephrosis. After the injection of phloridzin, the sugar will not appear in the urine for over an hour. This observation has been corroborated by Albarran, Braasch, and others. Another point has been noted by the writer, and that is that the companion kidney, with its normal pelvis, secretes a relatively large amount of albumin during the acuteness of the attack, and that the amount of urea excreted is diminished. Fortunately, it is seldom necessary to do a nephrectomy in these cases.

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* Acute septic infarct of the kidney is a possible exception to this rule.

Cystoscopic Examination.—This includes examination of the bladder, ureteric meatoscopy, ureter catheterism, and mensuration of the size of the renal pelvis.

Bladder.—Mucous membrane is usually normal. A cystitis may be present, but does not necessarily accompany the disease.

Ureter Openings.—In most cases there is some change to be noted. In those cases of congenital origin the meatus is long and teat-like, the diseased side showing more swelling and frequently some edema. The contractions, on the side corresponding to the disease, are weak and irregular, the urine oftentimes dribbling away, corresponding to the dribbling of urine from the penis with overdistention of the bladder due to prostatic obstruction.

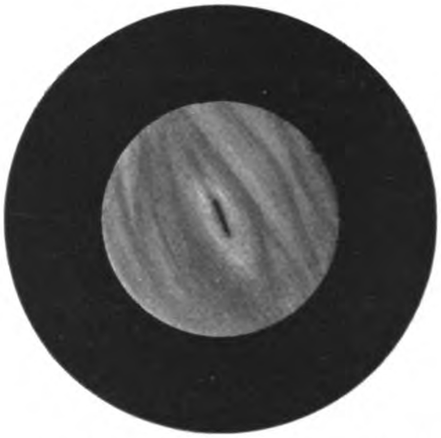

Fig. 205.—Cystoscopic picture of an elongated turgid ureter opening in a case of hydronephrosis (Fenwick).

Ureter Catheterism.—With a pendulous opening it is difficult to catheterize the ureter. When once entered, the catheter passes easily to the point of obstruction. In the congenital cases this is appreciated as a soft, easily passed obstruction, usually 20 to 25 cm. distant from the meatus. Kinks and valve-like formations and twists offer very little obstruction to the catheter. Tumors, extra-ureteral deposits, and inflammatory strictures may be encountered at any distance. An impacted calculus seldom causes a true intermittent hydronephrosis unless it is engaged at the ureteropelvic junction; it is evidenced by the presence of a more complete obstruction 27 to 30 cm. from the ureter mouth. As the catheter reaches the point of obstruction, the patient experiences acute pain, the catheter comes to a full stop, and, when forced forward, passes with a jump, in contradistinction to the smoothness with which it passes the congenital obstruction.

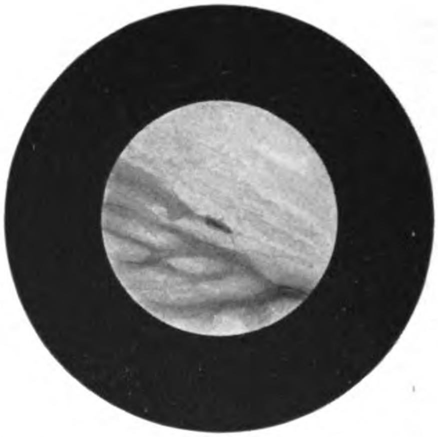

Fig. 206.—Cystoscopic picture showing a normal ureter opening as viewed through the same cystoscope (Fenwick).

As soon as the catheter enters the dilated pelvis, the

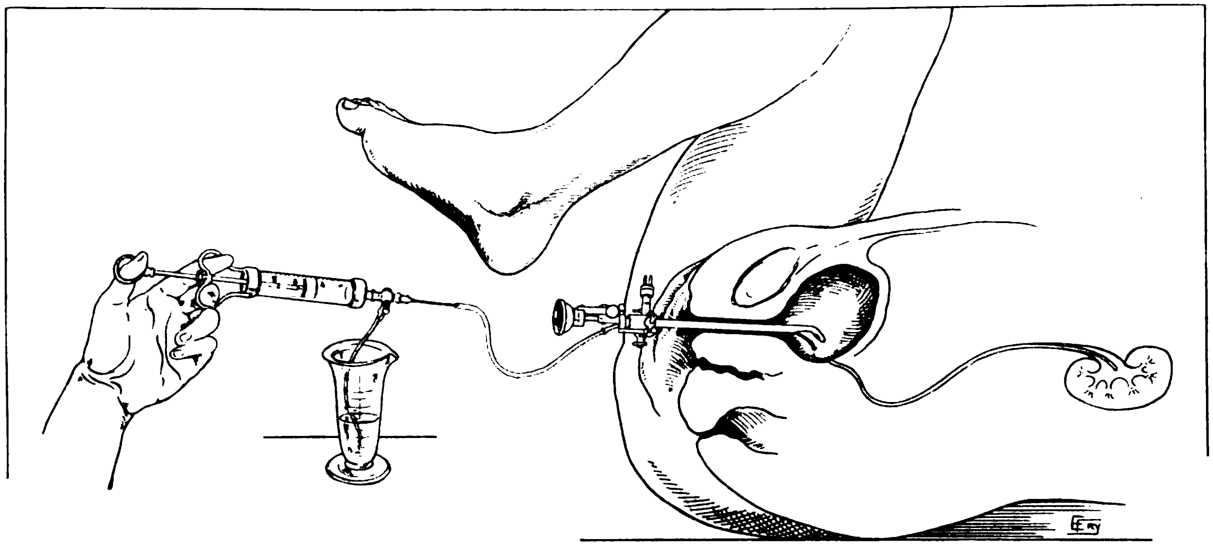

Fig. 207.—Diagram showing details of the technic of washing the renal pelvis. The diagram shows a section of the body with cystoscope in place, the beak within the bladder and the catheter in the ureter advanced to the pelvis of the kidney. The operator holds in his hand a syringe which is filled from the glass container below by means of a rubber tube attachment, and then the stop-cock is turned, closing the valve connecting with the glass container, and the fluid is forced through the catheter to the pelvis of the kidney. This method is permissible only for medicating the renal pelvis.

urine flows rapidly, without rhythm, and continues until the pelvis is empty. The first urine obtained is usually light colored, of low specific gravity, and contains few, if any, pus-cells. But as the pelvis empties itself the later urine is heavier, contains more pus, is more markedly alkaline, and contains phosphates.

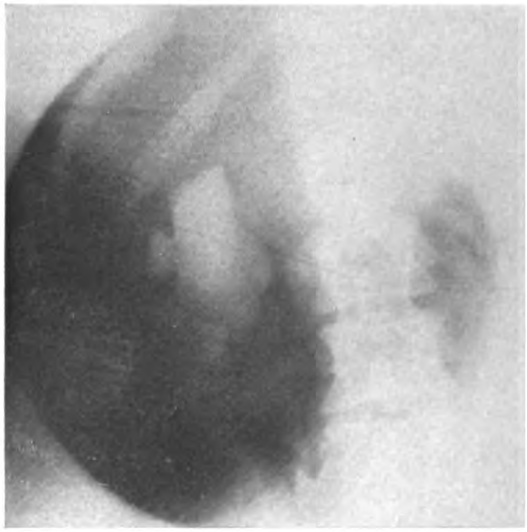

Fig. 208.—Radiograph showing mechanical distention in a case of hydronephrosis, with enormously dilated renal pelvis. The clear-cut outlines of the pelvis are characteristic of hydronephrosis, as differentiated from inflammatory dilatation of the renal pelvis. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

Determining the Deformity of the Renal Pelvis.—This combines the use of the ureter catheter and the *x*-ray. This subject is discussed in full under the heading of Pyelography.

Determining the Morphology of the Renal Pelvis.—This is done by injecting through the ureter catheter a 10 per cent. collargol solution,* or a warm 50 per cent. solution of colloidal silver oxid,† sufficient to distend the pelvis to its full capacity. An *x*-ray picture is then taken and the full outline of the pelvis will be seen (Figs. 203, 204, 208, 209). The method is discussed in full under the heading of Pyelography.

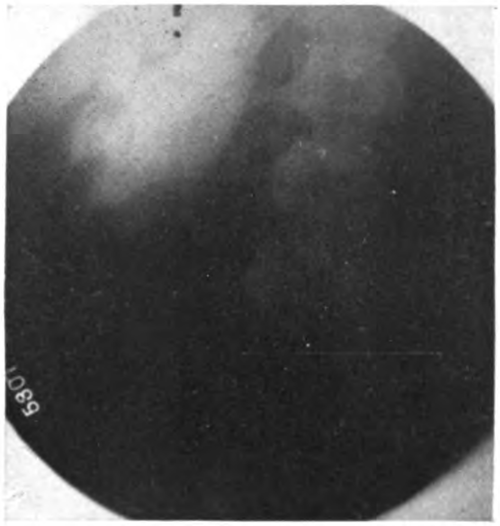

Fig. 209.—Radiograph showing mechanical distention of the renal pelvis in a case of hydronephrosis. Note the smooth, well-cut outline of the pelvis. In this case the kidney substance is almost totally destroyed. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

Diagnosis.—This depends upon the history of the case, which is fairly typical. The chief points are: Intermittent attacks of acute renal pain for a period of years; pain fairly well localized to the region of the kidney and not following the course of the ureter; no increased frequency of urination; tense, painful tumor felt in the renal region, usually slightly movable. Cystoscopic examination shows a pendulous meatus from which the urine is dribbling or coming in weak spurts. Through the ureter catheter the urine is collected from the pelvis of the kidney and the exact size of the distention may be measured. The urine usually shows a moderate number of pus-cells. The pain and tenderness disappear as soon as the urine is drained from the pelvis.

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* Braasch: Deformities of the Renal Pelvis, "Ann. of Surg.," vol. li, p. 534.

† Uhle, Pfahler, McKinney, and Miller: "Ann. of Surg.," vol. li, p. 551.

Differential Diagnosis.—In doubtful cases the diagnosis can usually be definitely established by ureter catheterism and exact measurement of the renal pelvis.

Renal Calculus.—Hydronephrosis may be the result of calculus formation. Frequently the two conditions cannot be distinguished without *x*-ray examination. With renal calculus the paroxysms of pain are more severe; the pain is transmitted along the ureter and into the scrotum or labium; there is always some increased frequency of urination; blood is almost invariably present; the *x*-ray will show a definite shadow in 95 per cent. of the cases. When the stone is descending the ureter, the changes in the ureter mouth are characteristic.

Tumors of the Kidney.—A benign or malignant growth of the kidney is seldom diagnosticated until attention is called to it by the appearance of a painless swelling in the renal region or the occurrence of a sudden hematuria. Renal colic is the exception. There is usually some deformity of the pelvis. It may be contracted or dilated, the dilatation, however, being very irregular. An *x*-ray plate may show a tumor-growth bulging into a dilated pelvis.

Appendicitis.—Sometimes confusing when the kidney is prolapsed. The pain in hydronephrosis is higher up and tenderness is generally determined in the intercosto-vertebral angle. There is absence of marked tenderness at McBurney's point; in some cases there is pus in the urine from the affected kidney. The ureter catheter, with pelvic distention, will give us an absolute guide, both as to size of the pelvis and the similarity of the pain produced by overdistention.

Cholecystitis and Cholelithiasis.—The position of a distended, inflamed gall-bladder and that of a hydronephrotic kidney on the right side are almost identical. The gall-bladder, under such conditions, lies directly over the kidney. With gall-stones the pain is referred more to the center of the abdomen, and is absent in the intercosto-vertebral angle; the attacks of colic are very much more severe. Cystic enlargement is confined more to the region directly beneath the rectus muscle and seldom occupies the loin. Cholelithiasis occurs in older people; may have jaundice and passage of gall-stones; attacks are more acute in onset with more marked gastric symptoms, and pain entirely subsides between times. Distention of the renal pelvis will simulate the pain if due to hydronephrosis; will differentiate it, if due to cholecystitis.

Pyonephrosis, pyelitis, and other renal diseases are not easily confused with hydronephrosis and will be discussed later.

Pancreatic cysts, ovarian cysts, and other abdominal tumors may be differentiated by the ureter catheter.

Indications for Treatment.—As already mentioned, a renal pelvis which contains more than 150 c.c. of fluid usually results in so much atrophy of the kidney parenchyma that nephrectomy is necessary. In the less advanced cases removal of the cause, with plastic reconstruction of the wall of the renal pelvis, will often restore the kidney to its normal functionating capacity. If a pyonephrosis results, nephrectomy is indicated.

The acute suffering due to overdistention may be relieved by withdrawing the retained urine from the renal pelvis. It is well to drain the renal pelvis and medicate the same for twenty-four hours previous to operation.

Therapeutic Uses of the Cystoscope in Hydronephrosis.—The patient is usually presented with an acute distention of the renal pelvis, suffering severely, with a moderate temperature, and a cystic tumor occupying the hypochondrium. The indication is first to relieve the acute retention. This may be done by passing a catheter to the renal pelvis and gradually drawing off the urine. If there is much sediment present, the renal pelvis should be washed out with warm saline solution or sterile water.

The ureter catheter should be left in place for three or four hours, if possible. After the first hour two drams of a 2 per cent. solution of collargol or half an ounce of a 1 in 500 solution of silver nitrate should be injected into the renal pelvis and withdrawn after ten minutes. This should be repeated before the catheter is finally withdrawn.

The ureter catheter may be left in place and used as a guide during plastic operations to correct ureteropelvic deformity.

CHAPTER II

SUPPURATIVE DISEASES OF THE RENAL PELVIS

ACUTE CATARRHAL PYELITIS

ACUTE catarrhal pyelitis of the kidney is entirely distinct from the so-called "surgical kidney," or suppurative pyelonephritis. It must be differentiated, as well, from suppurative nephritis and pyonephrosis. It is unilateral, as a rule, and consists of an inflammation of the lining membrane of the pelvis of the kidney, usually associated with dilatation of the same and with congestion of the parenchyma of the kidney, causing an enlargement of that organ with an engorgement of the vessels. The parenchyma, however, does not share in the infection, and it is probable that in the early stages there are no microscopic areas of suppurative inflammation in the kidney tissue.

The condition follows one of two courses: either a primary dilatation of the pelvis of the kidney and secondary infection, or primary infection of the pelvis with secondary dilatation. The condition of which we are speaking is usually, at first, unilateral.

Etiology.—The great predisposing cause is obstruction to the flow of urine from the kidney to the bladder. The obstruction causes a dilatation of the ureter and, in turn, of the pelvis of the kidney; when infection occurs, the mucous membrane becomes congested and the walls thickened and infiltrated; increased pressure in the pelvis causes, in turn, some renal degeneration.

Again, the conditions may originate as do other acute catarrhal conditions in the various organs of the body; just as we have an acute catarrhal inflammation of the mucous membrane lining the nose, throat, gall-bladder, and urinary bladder. It is often impossible in these cases, especially in catarrhal affections of the gall-bladder and urinary bladder, to trace the cause of the infection; we know, for example, that in the urinary bladder cystitis develops without a history of any traumatism or foreign body being introduced into the bladder. The same is true of acute catarrhal pyelitis. Exposure to cold, fatigue, etc., are contributing causes of pyelitis. The most frequent exciting cause is obstruction, such as that due to a movable kidney, with kinking, narrowing, or twisting of the ureter; second, extraureteral and intraureteral strictures; third, extension of infection from the bladder. Acute septic processes throughout the body are often complicated by acute catarrhal pyelitis.

Diagnosis.—Without going thoroughly into the symptomatology of the condition, the usual history of the case is of sudden acute pain in the region of the kidney, accompanied by the symptoms of a high fever, gastric disturbance, shock, and prostration; there is increased frequency of urination, which becomes painful, and the urine contains pus and renal cells. The kidney is always enlarged, tender, and, almost without exception, movable. The attack is of short duration and rapidly subsides under proper treatment.

Cystoscopy.—Cystoscopic examination and ureteral catheterism are necessary to establish the diagnosis. The ureteral mouth on the affected side is dilated and congested; the stream of urine comes from the ureter in steady drops and not in spurts, which is due to the lack of rhythmic contractions of the pelvis of the kidney and ureter.

Ureter Catheterism.—Catheterizing the ureter, the pelvis is found to be dilated and contains residual urine. The urine on the affected side shows the characteristics of a suppurative process.

The following cases will illustrate more forcibly the clinical picture:

Illustrative Cases of Acute Catarrhal Pyelitis

Case 1.—Mrs. E. A. W. Seen in consultation with Dr. H. Beekman Delatour and Dr. A. F. Griffiths. The patient, aged thirty-two, had been married sixteen years; one child one year after marriage; no subsequent pregnancies. General health, good. Family history, negative. One year ago had similar attack, which lasted ten days; bladder has since been slightly irritable. Periods, regular but scanty.

November 8, 1907. Bladder had been irritable for over twenty-four hours; woke up during night with feeling of discomfort in right side; then had a sudden sharp pain which radiated to right shoulder and downward. There was increased irritability of the bladder. The following morning there was a rise in temperature to over 100°. The muscles protecting the region of the right kidney were tense, and the right kidney was considerably enlarged, tender, and movable. During the succeeding twenty-four hours the temperature varied from 100° to 103°; leukocytes, 20,400; urine showed considerable pus; alkaline; no tubercle bacilli; no casts; some albumin.

November 10, 1907. The kidney seemed larger; pain not so severe; frequency of micturition increased; good amount of urine.

Examination, November 11, 1907: Kidney movable; no rigidity of muscles; temperature slightly higher; leukocytes, 16,400; good amount of urine.

Cystoscopic Examination, using the Pilcher Cystoscope: Bladder is the seat of a general diffuse inflammation; from the right ureter escapes cloudy urine.

Catheterized specimen from right kidney showed the urine to be acid in reaction; specific gravity, 1020; small amount of albumin; relatively large amount of pus forming in clumps; many round renal cells; no blood.

Catheterized specimen from the left kidney was normal.

The pelvis of the kidney was washed out with boric acid solution, the kidney carefully replaced, patient kept in bed, and urinary antiseptics administered. The third day after the examination the pulse and respiration were normal.

For two months the patient remained perfectly well, although there was still a small amount of pus in the urine. This finally disappeared.

Four months after this attack the patient passed through a second similar one. After recovery from this, her right kidney was exposed by operation and found to be prolapsed and twisted on its axis so that the ureter was markedly constricted at one point. The kidney was replaced in its normal bed and fixed by sutures. The patient made an uneventful recovery.

CASE 2.—Mrs. S., referred by Dr. William Linder. The patient, twenty-five years of age, was a woman of slight build and good general health. Three days previously she had been seized with severe pain in the right lumbar region, referred especially to the kidney zone. This pain was constant and radiated downward into the leg. There was no suggestion of the typical renal colic of intermittent type. The muscles protecting the kidney were tense. The patient at the onset had a chill, a sharp rise of temperature to 103.6°, accompanied by nausea and vomiting, and urination was painful and frequent. The third day after the onset the temperature had dropped to 101°, the pulse to 100. At that time the muscular spasm had subsided somewhat, and the kidney could be felt movable, prolapsed, enlarged, and tender. The urine was acid; of a relatively high specific gravity; contained a large amount of pus, the cells composing same not showing much degeneration; small amount of albumin; no blood.

Cystoscopic Examination: Left ureter opening, normal. Right ureter opening, slightly dilated and congested. A slight diffuse cystitis.

Ureter Catheterism: No obstruction to the passage of the catheters on either side. Urine from right kidney, acid, light in color, 1020; small amount of albumin, many pus-cells, no blood, many renal epithelial cells, no tubercle bacilli, a pure culture of bacillus coli communis. Urine from left kidney, acid, normal in color, sterile, and containing no abnormal ingredients.

The pelvis of the kidney was washed out with a mild solution of silver nitrate, 1 in 300, and the patient placed in bed. Urinary antiseptics administered.

The patient made a rapid recovery. The temperature became normal in three days, the pus disappeared from the urine in five days, and the patient has been well ever since.

Differential Diagnosis.—Many of the more advanced suppurative lesions of the kidney originate in repeated attacks of acute catarrhal pyelitis, not so much as a result of the catarrhal inflammation, but rather because the original cause of the trouble had become more pronounced, resulting in a long-continued obstruction or oft-repeated traumatism with consequent involvement of the renal parenchyma. The chief points of importance in differentiating this condition from other cases of acute suppurative disease of the kidney are:

1. The sudden onset, with severe, continuous pain in the region of one kidney. This occurs frequently, independent of motion or exercise.
2. Rapid rise of temperature, with other constitutional manifestations of fever.
3. Absence of blood in the urine.
4. Acute swelling of the kidney, easily palpable, usually occurring in a prolapsed, movable kidney.
5. Spasm of the muscles protecting the kidney.
6. By ureter catheter we may demonstrate: Pus and many renal epithelial cells in an acid urine from affected kidney. Usually a pure culture of colon bacillus. Urine from opposite kidney, normal. Pelvis of kidney, irritable.
7. Course of disease is acute and usually self-limited, provided the exciting cause is removed.

PYELITIS OF PREGNANCY

True pyelitis of pregnancy is an acute catarrhal inflammation in the pelvis of the kidney which occurs during the course of a normal pregnancy. It is acute in its onset, usually unilateral, affecting more frequently the right than the left kidney, running an acute course and tending to spontaneous recovery without permanent injury to the kidney. The cases which are considered under this head by the writer include only those cases in which there were no symptoms of pyelitis before the pregnancy.

Symptoms.—The usual history is that of a woman, pregnant from the fourth to the eighth month, whose previous history has been perfectly normal, when, without discovered cause or following exposure, during the night or when rising, is seized with severe, cramp-like pain referred to the abdomen; there is usually a slight chill, with nausea and vomiting; the pain recurs, is persistent, and usually localizes either in the bladder or in the region of one of the kidneys. It is to be remarked, in passing, that frequently all the pain is referred to the bladder; there is a sharp rise in temperature and the patient feels decidedly ill. Urination increases in frequency, becomes painful, and oftentimes the call for relieving the bladder is almost continuous; the chill, with rise of temperature, is repeated, and the patient has recurrent pains in the region of the kidney lasting for a few days.

The blood examination shows the typical picture of a suppurative process; usually a disproportionately large percentage of polymorphonuclear cells, generally above 85 per cent. and many times above 90 per cent.; the urine is usually acid and contains pus in varying quantities.

Physical Examination.—The muscles of the abdomen protecting the region of the affected kidney show spasmodic rigidity; and pressure, especially in the costovertebral angle, causes pain; the kidney is swollen and, if the uterus is not too large, the kidney can be palpated.

In an uncomplicated case the temperature gradually drops after five or six days, and in the course of two weeks becomes normal; the secretion of pus from the pelvis usually lasts for a considerable period of time after all symptoms of inflammation have subsided.

Cystoscopic examination reveals, usually, the bladder moderately inflamed, otherwise normal, except for the pressure upon it of the pregnant uterus (Fig. 145).

Ureter Catheterism.—Owing to the presence of the greatly enlarged uterus, some difficulty may be experienced in using the indirect catheterizing cystoscope. The ureter openings will be found usually on the sides of the central swelling caused by the uterus and will be much more widely separated than normally. In some cases it has been found necessary by the writer to use a direct catheterizing cystoscope. A catheterized specimen of urine from the affected kidney will show pus mixed with the urine and the evidences of an acute catarrhal pyelitis, while that collected from the other kidney is normal, except that it generally shows a large number of granular renal epithelial cells present. The mucous membrane of the healthy ureter and kidney bleeds more easily than that of the diseased side.

ILLUSTRATIVE CASES OF PYELITIS OF PREGNANCY

CASE 1.—A woman, twenty-six years of age, referred by Dr. O. Paul Humpstone. Primipara; last period six and a half months previous to examination. Twelve days ago patient was awakened in the morning with a sharp, stabbing pain in the left lumbar region, which was relieved by hot applications. She vomited; voided urine involuntarily. Urine was loaded with pus. Her temperature ranged between 97° and 101°; leukocytosis of 13,000; polymorphonuclear cells, 90 per cent. During the next twenty-four hours the pain in the left renal region did not abate and she was taken to the hospital.

Cystoscopic Examination: Moderate degree of cystitis; left ureter opening slightly inflamed; urine collected from left kidney showed a few hyaline casts, epithelial cells from the pelvis of the kidney, many pus cells, and polymorphonuclear leukocytes. In a single field, under the microscope, using 7-A objective and a No. 2 eyepiece, there were sixty pus-cells. Urine from right kidney showed a few leukocytes, and a number of red blood-cells, probably of traumatic origin, also a few hyaline casts. The pelvis of each kidney was washed with a 25 per cent. solution of argyrol.

Bacteriologic Examination: Urine from the left kidney showed a pure culture of colon bacillus; from right kidney, sterile.

Patient was placed in the elevated head-and-trunk position, urotropin was given, and the bladder was irrigated with 25 per cent. solution of argyrol twice a week. The temperature rapidly dropped to normal and remained so.

One week later a second examination was made and the pelvis of the left kidney again irrigated with argyrol; urine from this kidney at the second examination showed very few pus-cells present, and all the signs of inflammation had subsided; next day patient was allowed out of bed. At the end of another week the patient was discharged from the hospital entirely recovered.

Remarks: This case presents the typical picture of an acute catarrhal pyelitis of pregnancy, probably due to pressure of the enlarging uterus. The infecting agent was the colon bacillus.

CASE 2.—Multipara, in the ninth month of her pregnancy; previous pregnancies, normal.

On December 21, 1908, patient was seized with a sudden chill and sharp pain in the right lumbar region and had repeated chilly sensations followed by a high fever. Marked frequency of urination and pain on urination.

Blood Examination: Leukocytes, 20,500; polymorphonuclears, 90 per cent.; urine, acid; specific gravity, 1016; moderate amount of albumin; no sugar; loaded with pus-cells; few renal cells; no other evidences of nephritis. Temperature ranged from 99° to 102° every day; pulse from 90 to 125.

Cystoscopic examination, two weeks later, showed a moderate cystitis to be present; ureters catheterized; right kidney pelvis contained 4½ ounces of residual urine and pus; the first half ounce of urine collected showed only a small amount of pus, the second half ounce a little more, the third ounce still more, and the fourth ounce contained urine loaded with pus; urine from the left kidney was normal in every way. On account of the large amount of residual urine in the pelvis of the right kidney, the catheter was left in place after injecting the pelvis with 25 per cent. solution of argyrol; the catheter remained in the ureter for five hours, and at the end of that time the pelvis of the kidney was again irrigated with 25 per cent. argyrol solution. Patient was turned on the left side, was postured with head and trunk raised, pelvis lowered, urotropin administered, and daily irrigations of the bladder given. The following day the temperature became normal and remained so.

Bacteriologic examination revealed a Gram-positive and a Gram-negative bacillus and diplococcus, varying in size, spore-bearing, and fermenting sugar.

Patient made an uneventful recovery and left the hospital before the birth of her child.

Remarks: The patient was treated expectantly for two weeks with the hope that she would not need to have her kidney pelvis irrigated; her course, however, was not satisfactory and renal lavage, with drainage, was necessary.

Differential Diagnosis.—The symptoms are due to an acute catarrhal pyelitis of the kidney, occurring between the third and ninth month of pregnancy. It is usually unilateral, but may be bilateral. The points of diagnostic value are the same as those given for acute catarrhal pyelitis, on page 342, with the addition of the pregnant state as a known etiologic factor.

INDICATIONS FOR TREATMENT IN ACUTE SUPPURATIVE DISEASE OF THE RENAL PELVIS

If the symptoms are not too severe, it is usually safe to wait a week or ten days before resorting to ureter catheterism. If at the end of this period there is a persistent temperature, with pain and pyuria, or even without pain, it is indicated·to pass a catheter to the pelvis of the affected kidney, to drain it thoroughly, and then to instil a solution of one of the silver salts. In case there is a large amount of residual urine in the pelvis of the kidney, with considerable pus present, it is indicated to leave the ureteral catheter in place for four or five hours, washing the pelvis of the kidney repeatedly with some antiseptic solution.

In acute catarrhal pyelitis of pregnancy the induction of premature labor is seldom necessary. In a series of fifteen cases under the writer's care the expulsion of the fetus occurred in two cases; once in a case of double pyelitis, in which the fetus was already dead, and once an abortion took place after operation for removal of an appendix before it was known that the patient had an acute pyelitis of the right kidney. In the entire series of cases, as far as known, the patients have entirely recovered.

NOTES

Late Pyelitis Cases.—It may be well to emphasize that there is a distinctly chronic stage to many pyelitis cases. This applies equally to the puerperal, post-operative, and post-prostatic cases and those arising from a kink of the ureter or from a stricture of the ureter. Frequently a case comes to our notice which has been overlooked by the general practitioner in which the patient has been suffering only moderately for months without any particular symptoms, and then suddenly develops the typical symptoms of pyelitis, which last for only a few days. Usually the urine catheterized from the bladder shows both leukocytes and bacteria, although occasionally there is pure bacteriuria without pus-cells; these cases are hard to clear up because they frequently are due to some slight obstruction in the ureter near the bladder. If the kidney is washed out without special dilatation of the ureter, trauma of the strictured area takes place, with retention in the pelvis of the kidney following, and the patient develops chills and typical symptoms of pyelitis which last for a few hours. Such cases are prone to have recurrent attacks at the time of menstrual congestion, due probably to temporary swelling of the strictured area. In these chronic cases the kidney is only slightly tender, and often not appreciably enlarged or more than normally movable. (Note by Guy L. Hunner, of Baltimore.)

Many cases of acute catarrhal pyelitis in children and women are bilateral. In pure pyelitis the temperature is never very high. Pathologically, the pyelitis of pregnancy is not a distinct type. (Note by Hugh Cabot, Boston.)

CHAPTER III

ACUTE SUPPURATIVE DISEASES OF THE PARENCHYMA OF THE KIDNEY

It is not the writer's purpose to give in detail all of the various forms of acute suppurative disease of the parenchyma of the kidney, but only those details which are necessary to establish the diagnosis.

There are two clinically different types of acute infection, resulting in pathologic changes, which may be discussed to advantage:

(*a*) Acute unilateral septic infarcts of the kidney.

(*b*) Acute pyelonephritis.

ACUTE UNILATERAL FOCAL NECROSIS OF THE KIDNEY

The work of Brewer, Cobb, Israel, Johnson, and others has demonstrated that acute hematogenous and lymphatic infection of one kidney frequently takes place. Further, that the lesions produced are multiple, septic infarcts, which may or may not suppurate and form abscesses.

Symptoms.—This condition occurs most frequently in women between the ages of twenty and forty, and has been observed to affect the right kidney more often than the left. There is usually a history of some traumatism to the kidney or some condition of lowered vitality.

The onset of the disease is sudden, usually ushered in

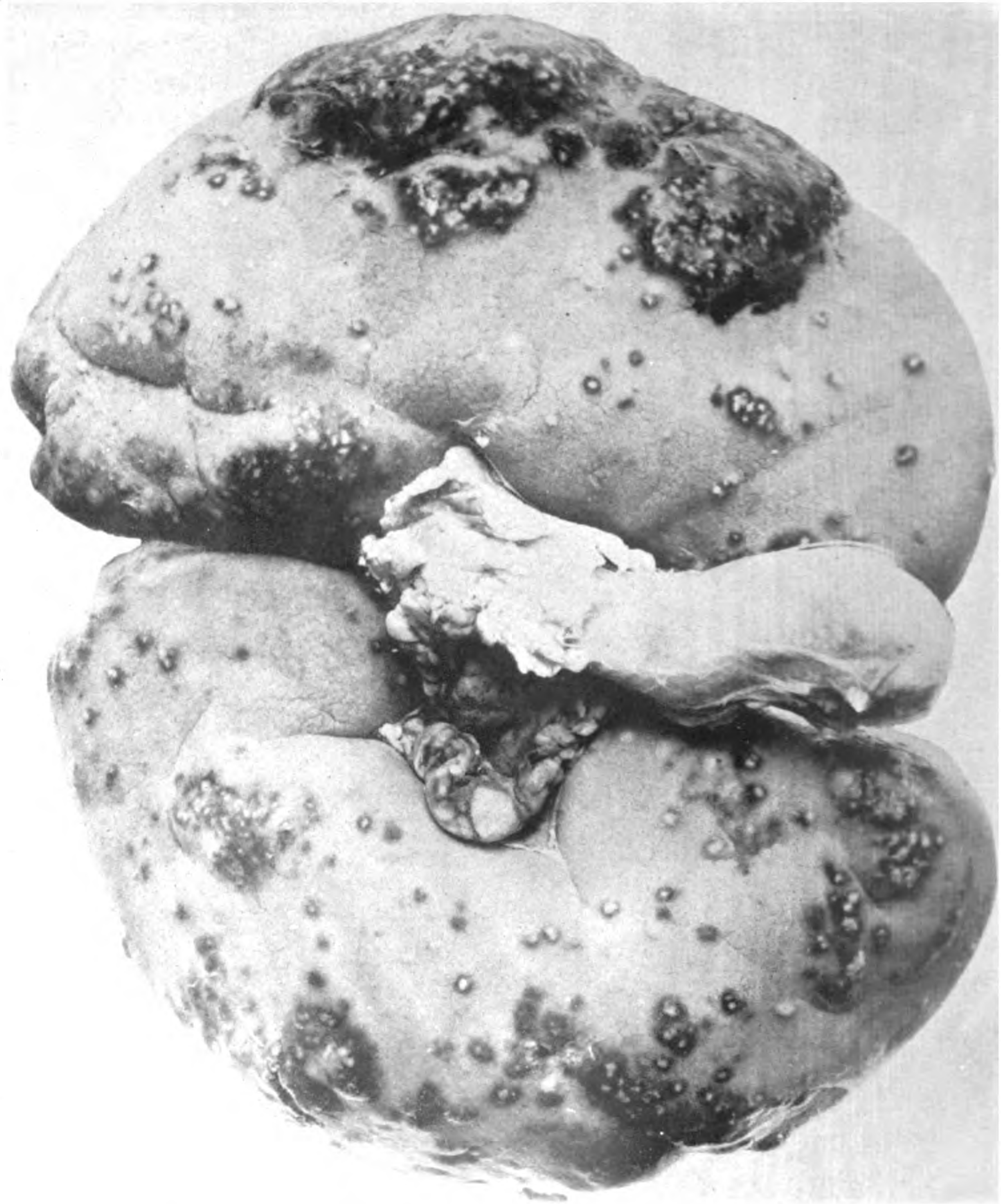


Fig. 210.—Acute hematogenous infarct of the kidney. In the earlier stages of this condition there may not be any pus present in the urine, but later it is almost invariably present (Brewer).

by a chill, with sudden rise of temperature to 104° or 105°, increased pulse-rate, and the rapid development of a septic state. The local manifestations are slight, and may be easily overlooked, being insignificant in proportion to the degree of the toxemia. The disease may run its course without the development of any subjective symptoms referable to the genito-urinary tract.

The chief complaints are abdominal pain, fever, and prostration. The pain may be referred to any part of the abdomen, seldom localizing in the renal zone. It has, in different cases, been variously interpreted as due to appendicitis, cholecystitis, duodenal ulcer, ovarian cysts with twisted pedicle, etc.

The chief points of diagnostic value are:

Exquisite tenderness in the costo-vertebral angle.

Marked rigidity of the muscles protecting the affected kidney.

The presence of albumin, pus-cells, and red blood-cells in the urine obtained by catheter from the diseased kidney.

A state of severe toxemia, with septic temperature, occurring suddenly in persons apparently well.

Bladder irritability is not a prominent symptom.

Cystoscopy.—The only value of cystoscopy in these cases is to establish the presence of a second kidney and to demonstrate the pathologic ingredients of the urine as coming from the kidney on the affected side. This last may be misleading, since pus is not always found in the urine during the early stages and blood may be due to traumatism.

ACUTE PYELONEPHRITIS

Pyelonephritis is quite distinct clinically and pathologically from the type of renal disease just described. The infection may reach the kidney by direct extension from the pelvis of the kidney or ureter, by direct infection of a wound of the kidney, or secondary to some other focus of suppuration in the body. The most frequent cause is an ascending infection from the bladder, usually following urethral or prostatic obstruction with retention of urine, cystitis, and ureteritis. A frequent avenue of infection is along a ureteral fistula.

Etiology.—The inflammation involves both the pelvis of the kidney and the parenchyma, the extent of the lesion varying in each case. The history of the case almost invariably includes that of some antecedent disease or injury of the genito-urinary tract: in old men, hypertrophy of the prostate; in young men, gonorrhea; and in women, pyelitis and pyosalpinx or some pelvic peritonitis. It is especially common in post-operative cases following an injury to the ureter. In other words, it is the sequel usually of some acute or active disease of the genito-urinary tract in contradistinction to pyonephrosis, which is the result of chronic, long-continuing irritation and obstruction.

Symptoms.—The symptoms are oftentimes misleading unless we have an antecedent history of disease or injury of the ureter or kidney to guide us. There is, at first, a low-grade type of sepsis indicated by an irregular temperature, suggestive of malaria, a more or less continuously rapid pulse, loss of appetite and strength, and gastro-intestinal irritation. There is urgency of urination which becomes painful if a cystitis is present. When the ureter is injured and the urine from the diseased kidney does not reach the bladder, no bladder symptoms are present. As the disease advances, a more profound degree of sepsis is evident, showing all of the characteristics of a general toxemia or septicemia.

The local symptoms are often very insignificant. The patient does not complain much of pain in the region of the kidney, and frequently refers to the opposite kidney as the source of the trouble.

Palpation will usually demonstrate an enlargement of the kidney; always, if the kidney is movable and prolapsed. The organ is tender, but not exquisitely so. The muscular rigidity is not marked.

Cystoscopic Examination.—The bladder usually shows some cystitis, confined mostly to the trigone and posterior wall of the bladder. The ureter opening corresponding to the diseased kidney is congested and swollen and lacks tone. It may show any of the inflammatory changes occurring with acute or subacute pyelitis.

The urinary efflux, while lacking force, still retains its rhythmic character unless the ureter shares in the disease. The macroscopic characteristics of the urine depend on the individual case. In general, it may be said that the urine is *never thick with pus,* the pus-cells being evenly distributed throughout the fluid and only in sufficient numbers to cause a heavy cloud.

In *ureteral catheterism* the catheter meets with no obstruction due to the disease itself. The urine collects in the usual manner, with the exception that there is less rhythm if the opening of the catheter is within the pelvis of the kidney.

Urine from the diseased kidney is usually acid, contains albumin, pus, pus-casts, renal epithelia, granular and hyaline casts, bacteria, and usually a few blood-cells. Urine from the second kidney shows the changes of a compensating hypertrophy, with many granulated renal epithelia and blood due to the traumatism of catheterism.

The functional activity is markedly impaired on the side of the lesion and lessened in the second kidney.

As a result of ureteral fistula, where there has been an injury to the ureter, the urinary findings are entirely different. Under these circumstances, there is a history of an operation or wound involving the ureter. A ureteral fistula is in evidence. Cystoscopic examination shows the urine coming normally from a healthy ureter opening on one side, while the other ureter opening, although frequently contracting and showing good sphincteric action, still is dry, no urine escaping. A ureter catheter passed into this side will find an obstruction at the point of injury, usually at the vesico-ureteral junction, but occasionally higher up. When the catheter reaches the injured point, the patient experiences pain.

Diagnosis.—A definite diagnosis can only be made after careful examination of the patient, weighing the history, physical examination, and results of the cystoscopy and the urinary findings.

As a rule, we are confronted with a case of low-grade sepsis of obscure origin. Our task, then, is not so much to differentiate between various renal lesions, but to discover whether or not the septic focus is in the kidney. The writer knows of no short or sure method of doing this.

One must arrive at a conclusion based on the positive cystoscopic findings and physical examination.

Indications for Treatment.—Few cases of pyelonephritis have been influenced by medical treatment. The indications are for exposure of the kidney. If the lesion is diffuse, nephrectomy is the operation of choice; if a circumscribed area is involved, a resection of the kidney may be done.

If pyelonephritis develops after injury to the ureter, the indication is for nephrectomy. Nothing can be hoped for from repair of the ureter.

Lavage of the renal pelvis will not materially influence the course of the disease.

ILLUSTRATIVE CASE

CASE.—Patient well until rupture of uterus occurred during labor, on December 15, 1909. She was admitted to the hospital, and a hysterectomy was performed the same day. Following the operation she did well, but developed a uretero-vaginal fistula. January 12, 1910, she developed an exudate in the pelvis, which was opened and drained through the anterior abdominal wall. She did well for three weeks following this operation, but after that showed symptoms of a low-grade sepsis, running a continuous, irregular temperature, reaching as high as 104.6°, with a correspondingly high pulse-rate. These conditions continued without any localizing symptoms, the patient complaining of pain in the back, both sides, soreness in the lower abdomen, nausea, loss of appetite, and headache. There was a foul, sero-purulent, urinous discharge from the vagina. There was tenderness in the region of the right kidney and across the lower abdomen. She was examined by a number of able surgeons without a definite diagnosis being made.

On February 25, 1910, a cystoscopic examination was made. Bladder showed a slight cystitis of the posterior wall; left ureter opening, normal; right ureter opening, congested and showed occasional contractions of the sphincter, but no efflux of urine. Urine from the left kidney by catheter showed a normal urine with numerous renal epithelia. Catheter introduced into the right ureter passed for 9.5 cm., when it met with a tender, impassable stricture or obstruction. No urine flowed through the catheter. Urine collected from the vagina was alkaline, containing large amounts of pus, and was mixed with the vaginal secretions.

Physical examination showed some enlargement and tenderness of the right kidney.

A diagnosis was made of pyelonephritis of the right kidney, injury of the ureter at or near the pelvic brim, and right uretero-vaginal fistula. Nephrectomy was advised.

At operation the right kidney was removed and the ureter as far down as the pelvic brim. The kidney was the seat of a diffuse pyelonephritis with beginning abscess-formation. The patient made a complete recovery.

It is hardly necessary to give in detail the history of cases of pyelonephritis developing from wounds of the kidney and from ascending infections from the bladder. The essential features in the history of the case are the same.

A case of pyelonephritis may rapidly develop into one of general septicemia, or it may infect the surrounding tissue and produce a perinephritic abscess; again, it may develop into a pyonephrosis.

Acute suppurative nephritis and abscess of the kidney are simply different stages of the same pathologic condition and cannot be clinically differentiated from pyelonephritis.

CHAPTER IV

CHRONIC SUPPURATIVE DISEASES OF THE KIDNEY

PYONEPHROSIS

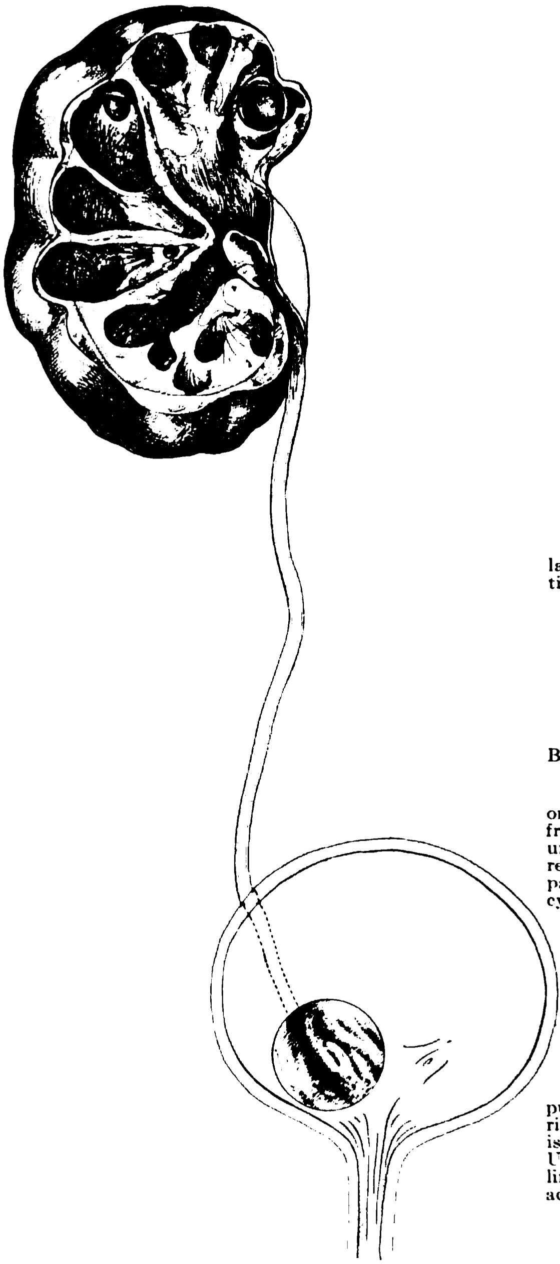
PYONEPHROSIS is usually the result of long-continued suppuration of the kidney, associated with obstruction. It may develop from an infected hydronephrosis, a renal calculus with an infected pelvis, a chronic pyelitis, a pyelonephritis, or abscess of the kidney.

Usually, the pelvis of the kidney is distended, the calyces are dilated, and there is a considerable retention of foul urine mixed with pus in the renal pelvis. The parenchyma suffers from pressure atrophy with secondary interstitial changes. All degrees of destruction are seen, from that consisting of a dilated, distorted pelvis lined with a thickened pyogenic membrane and a moderate pressure atrophy of the renal substance, to the more advanced forms in which the kidney is converted into a mere shell or pus sac.

Symptoms.—The course of the disease is usually chronic, giving a history of some urinary disturbance lasting for months or years. The original lesion may be referred to the urethra, prostate, bladder, ureter, or kidney, and is always associated with infection.

The patient is usually presented complaining of dull aching pains in the back or lumbar region and symptoms of a chronic, low-grade sepsis. Frequently the pain is

PYONEPHROSIS



Kidney Symptoms.

Dull local pain and backache of long standing. Gradual enlargement of kidney. Acute exacerbations of pain and colic, with septic symptoms, together with sudden increase in size of kidney and fever. Tender mass usually palpable in renal region.

Pelvic Distention.

Will usually contain over 50 c.c. of fluid.

Ureter Catheter.

Continuous dropping from catheter. Estimation of residual urine. Characteristic urinary findings. Pus, bacteria, albumin.

Meatoscopy.

Almost invariable relaxation, congestion and dilatation of ureter opening.

Cystoscopy.

Usually mild grade of cystitis. Frequently none.

Function Tests.

Markedly delayed functional activity.

Bladder Symptoms.

Slight, may or may not be frequency of urination. No reflex ureteral pain or frequency.

Urine.

Loaded with pus and bacteria. Hematuria is the exception. Usually alkaline; may be acid.

Fig. 211.—Showing signs and symptoms and cystoscopic appearance of the ureter opening in chronic suppurative diseases of the kidney.

more severe and paroxysmal in character, being increased by motion. There are usually periods of complete relief from all symptoms. The pain depends mostly upon the character and extent of the obstruction.

Symptoms Referred to the Kidney.—Aside from the shifting pain, there are usually local objective symptoms which point to the affected side. The kidney is invariably enlarged at some stage of the disease and remains so unless the obstruction is removed. Usually, it is distinctly palpable as an irregular, tender tumor presenting below the free border of the ribs and palpable on bimanual examination in the lumbar region. The symptoms of any associated lesion, such as tumor or renal calculus, may also be present.

Symptoms Referred to the Bladder.—These are variable, but usually there is increased frequency of urination due to chronic cystitis. There is no reflex ureteral pain.

Urine.—Pyuria is the only constant symptom. A persistent, painless pyuria of renal origin, without the characteristic symptoms of tuberculosis of the kidney, is pathognomonic of pyonephrosis. Clear urine is sometimes associated with a sudden blocking of the ureter on the diseased side. Hematuria is the exception. It is a sign of advanced nephritis if present.

The constitutional symptoms vary with the individual case. Sometimes they are marked, with fever, nausea, vomiting, and prostration, while in other cases they are lacking.

Cystoscopy.—We frequently find that although there has been a chronic suppurative lesion of the kidney of long standing, pouring pus and bacteria into the bladder, the bladder itself is practically free from any signs of inflammation except in the immediate neighborhood of the ureter opening. This is an important point in the differential diagnosis between tuberculosis of the kidney and pyonephrosis. In the former the bladder is almost invariably involved and extremely intolerant, while in the latter the bladder is often free from disease and will contain large amounts of fluid without causing discomfort to the patient.

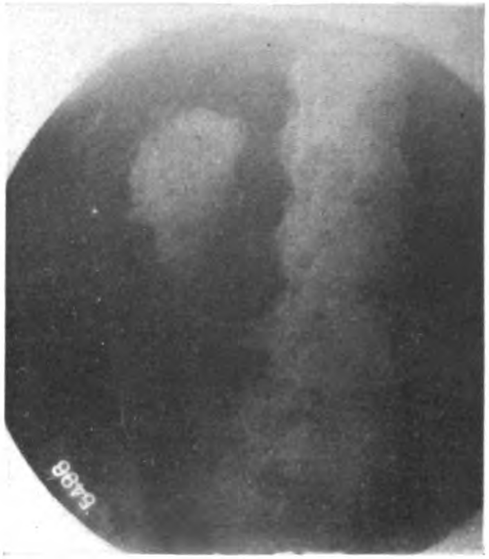


Fig. 212.—Radiograph of a case of pyonephrosis with inflammatory distention of the renal pelvis. Note the irregular, ill-defined outlines of the shadow. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

Meatoscopy.—The ureter opening corresponding to the diseased kidney almost invariably shows some pathologic change, usually a relaxation and distortion of the opening, associated with more or less marked inflammatory changes in the mucous membrane. It is not safe to depend on this alone as a basis for diagnosis; we must either distinctly see pus mixed with the urine escaping from the opening, catheterize both ureters, or separate the urines by using a segregator.

The urinary efflux on the diseased side is less forceful, smaller in amount, and shows urine mixed with pus. In some advanced cases solid plugs of pus have been seen issuing from an opening.

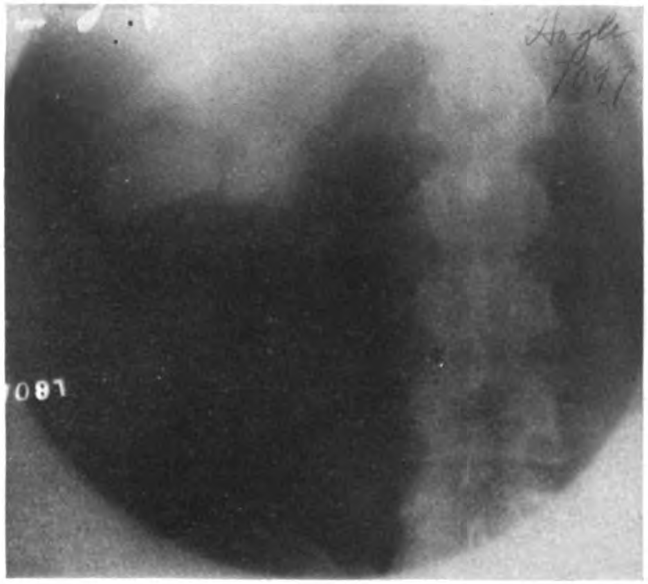


Fig. 213.—Radiograph of the renal pelvis in a case of pyonephrosis showing an inflammatory distention and tumor. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

Ureter catheterism, in the opinion of the writer, is indicated in every case before an exact diagnosis can be made, and before any operation is undertaken. In the majority of cases, when examined, the ureter on the diseased side will be found to be dilated and there will be a lack of the rhythmic contractions of the renal pelvis, as shown by the steady, continuous droppings from the ureter catheter, instead of the rhythmic droppings, with periods of rest, usually seen. The catheter will show a considerable amount of purulent, residual urine in the renal pelvis.

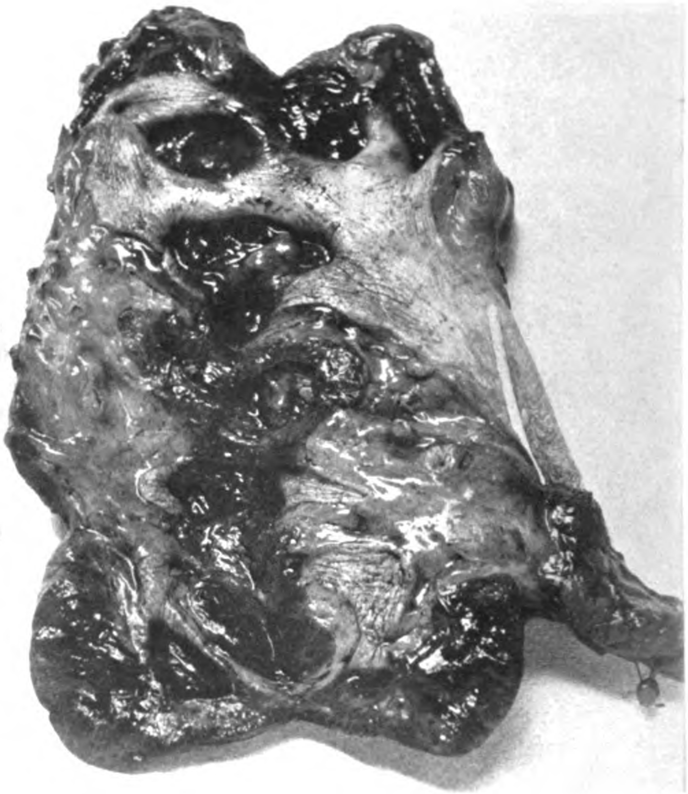


Fig. 214.—Cut surface of the kidney in a case of pyonephrosis. In this case there was no tumor palpable in the renal region. Cystoscopic examination showed a large amount of pus and urine of a low specific gravity coming from the right side.

Mensuration of the pelvis of the kidney and an *x*-ray picture will show the extent of the deformity of the kidney.

Functional tests show a marked retardation of the phloridzin test on the side of the lesion.

Urinary Examination.—On the side of the lesion the urine may be alkaline, neutral, or acid, depending on the amount of residual urine; of varying specific gravity; containing albumin and but few casts; many renal epithelia (variable); loaded with pus-cells; red blood-cells in proportion to the nephritis. From the sound kidney there is usually a trace of albumin, a few leukocytes, and many renal epithelia; at times, a varying number of hyaline casts.

Diagnosis.—As a rule, this is not difficult, and the diagnosis can be made with certainty by means of the cystoscope and microscopic examinations of the separately collected urines. The characteristic features are:

1. The history of some previous urinary disease.
2. The persistence of a low-grade septic state marked by headache and mild gastric disturbances, with an irregular temperature.
3. A persistent, painless pyuria of renal origin.
4. Pain of varying severity, always associated with one or the other kidney.
5. A tender enlargement of the kidney.
6. The positive cystoscopic findings.

The diagnosis of pyonephrosis is made from the positive findings and not by exclusion.

ILLUSTRATIVE CASES

CASE 1.—A woman, thirty years old, complained of pain in the left hypochondrium for four years; during the last year noticed a marked cloudiness in the urine; frequent attacks of sharp pain in the left renal region, accompanied by nausea and fever; at these times the urine would appear almost clear. There was no painful urination.

Examination: Abdominal, showed an irregular, tender tumor mass in the left hypochondrium, moving with respiration. Bimanual palpation demonstrated that the mass occupied the position of an enlarged kidney.

Urine Examination: Very heavy sediment, strongly alkaline, foul-smelling, and contained considerable albumin and many pus-cells.

Cystoscopy: Bladder capacity, 12 oz. Medium cleared quickly after a single irrigation. Subacute cystitis, mostly involving the posterior wall. The left ureter opening was very lax and dilated, the mucous membrane congested and swollen, and showing small shreds of tissue coming from the opening. There was no force to the urinary efflux. Urine was distinctly cloudy from the left side. Right ureter opening, normal.

Ureter Catheterism: Both sides easily catheterized. Left ureter opening stretched easily.

Examination of Catheterized Specimens

	LEFT KIDNEY	RIGHT KIDNEY
Amount	Six drams	Two drams
Condition	Thick with pus	Clear
Reaction	Alkaline	Acid
Specific gravity	1010	1020
Albumin	Large amount	Trace
Microscopic examination	Pure pus	Renal epithelia. A few leukocytes and red blood-cells
Phloridzin reaction	Negative	Positive in 20 minutes
Size of renal pelvis	Will contain 100 c.c. without discomfort	15 c.c. of fluid injected causes pain
Bacteriology	Culture showed colon bacillus	Culture, sterile

Diagnosis: Pyonephrosis of left kidney. A thickened and dilated left ureter. Subacute cystitis. Right kidney showed compensatory hypertrophy and was capable of carrying on the functions of both organs.

CASE 2.—A woman, twenty-three years old, had passed through three pregnancies. During the last one, three years ago, she had some pain and tenderness in the right hypochondrium. For two and a half years had had attacks of pain in the right lumbar region, sharp and stabbing in character, recurring at short intervals, and radiating toward the umbilicus; at the same time she had had more or less severe chills, nausea, and vomiting; there was also increased frequency of urination, but unaccompanied by pain. During these attacks the patient felt a distinct mass below the free border of the ribs on the right side; this became smaller after the pain subsided. Patient always passed a larger quantity of urine after an attack; the urine, which was dirty-white in color, became highly colored during the attacks of colic, which lasted from thirty-six to forty-eight hours. Patient had an irregular, intermittent temperature, ranging from 99.6° to 101.5°; pulse-rate, 90 to 125 per minute.

Examination revealed a tumor presenting on the right side of the abdomen below the free border of the ribs, extending as far down as the umbilicus. Moved with respiration, slightly tender, and occupied the position of a prolapsed, enlarged kidney, somewhat cystic on palpation.

Cystoscopy: Bladder cleared quickly when irrigated; capacity, 14 oz.; not irritable. Slight cystitis; no ulcerations. Right ureter opening, slightly dilated and pendulous; left ureter opening, normal.

Ureter Catheterism: No obstruction in either ureter. Urine flowed slowly from each side. Catheter on right side became plugged with pus; urine from the left kidney was clear.

Examination of Urines Obtained by Ureter Catheter

	LEFT KIDNEY	RIGHT KIDNEY
Amount	One ounce	Two drams
Condition	Clear	Purulent
Reaction	Acid	Faintly acid
Specific gravity	1018	1015
Albumin	Trace	Large amount
Phloridzin reaction	Positive in fifteen minutes	Negative after thirty minutes
Microscopic examination	Renal epithelia and a few leukocytes	Loaded with pus and bacteria

CHAPTER V

TUBERCULOSIS OF THE KIDNEY

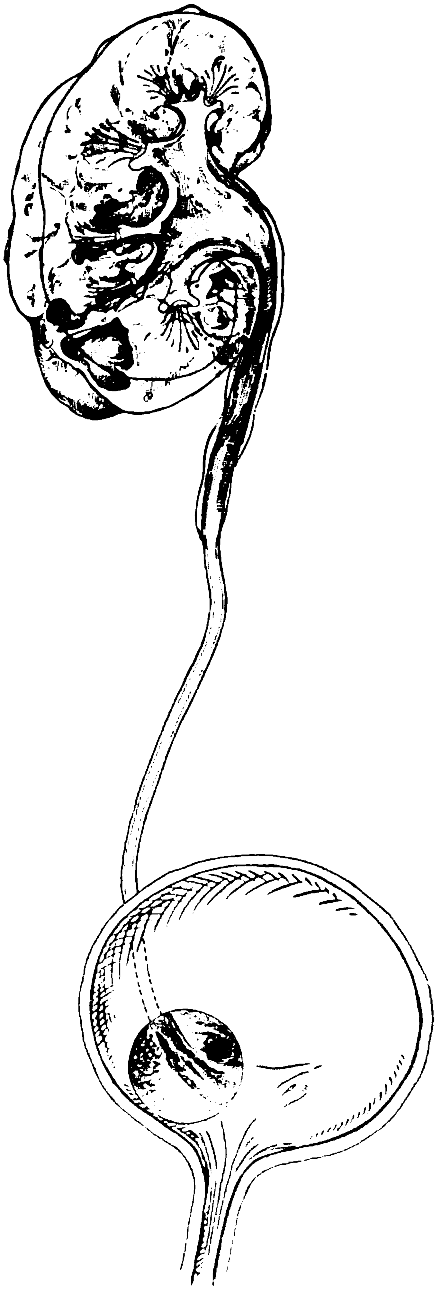
THERE are few diseases in which the diagnosis can be more perfectly worked out than in tuberculosis of the kidney. Cystoscopy is an extremely important aid, first, to establish the character and stage of the disease; second, to discover the extent and location of the lesion, and, third, to determine definitely the functional activity of both kidneys.

Tuberculosis of the kidney is by no means so rare a disease as was formerly supposed. Küster found that 10 per cent. of those dying of tuberculosis showed renal involvement. Both Krönlein and Israel reported that about one-third of all their cases of suppurative disease of the kidney were due to tuberculosis.

The disease is found most frequently in adults between the ages of twenty and forty years, affecting men and women equally. Ninety per cent. of the cases when first examined show involvement of only one kidney.

The course of the disease is chronic and long continued, and almost always proves fatal unless relieved by surgical means.

Symptoms.—The onset of the disease is so insidious, and the symptoms referable to the kidney are so slight, that attention, as a rule, is not called to the kidney as a source of a persistent pyuria or vesical irritability



Palpation.
Usually some enlargement, moderately tender.

Pain.
Not a prominent symptom until late in the disease. Some cases have severe pain. Others moderate and long continued. Mostly referred to the bladder.

Phloridzin Test.
Markedly delayed appearance of sugar.

Ureter Catheter.
Obstruction to passage in lower end of ureter. Multiple strictures in some cases. Urine flows rapidly, marked polyuria. Urine pale, low specific gravity, acid; pus; tubercle bacilli.

Second Kidney.
Many renal epithelial cells; trace of albumin.

Meatoscopy.
Urinary efflux difficult to see. Region of meatus usually shows hyperemia, tubercular nodules, ecchymosis, or ulceration. Opening is distorted or stiff. Sometimes elevated and crater-like.

Bladder Mucosa.
Usually shows tubercular cystitis, localized to side of disease. Later extensive involvement of bladder.

Bladder Symptoms.
Frequent and painful urination. Intractible pyuria and polyuria.

Fig. 215.—Showing signs and symptoms and cystoscopic appearance of the ureter opening in tuberculosis of the kidney.

until the lesion is well advanced. In the majority of cases subjective renal symptoms are late in their appearance. Some patients complain of dull aching in the region of the affected kidney; in women it is usually increased during the menstrual period. Frequently the kidney on the opposite side gives rise to some symptoms due to the compensatory congestion and hypertrophy. These symptoms are all mild at first, usually calling for the exhibition of some urinary antiseptic and possibly bladder irrigation. The average duration of symptoms before consulting the surgeon varies from one to three years. Exceptionally, the process will run a rapid course and cause complete destruction of a kidney and ureter within a year.

Objective Symptoms.—As a rule, the affected kidney will be found to be enlarged. The enlargement, however, may be no greater than that of the opposite kidney, which is congested and hypertrophied. Tenderness may or may not be present over the affected kidney. If one is able to grasp the diseased organ between the fingers, some irregularity in its surface will be noted and tenderness on pressure will be found. *It is frequently the case that the sound kidney is more sensitive than the diseased one.*

Subjective Symptoms.—The usual symptoms of inflammatory disease of the kidney are lacking unless the ureter becomes suddenly blocked. There is no renal colic, no pain referred along the ureter, no vomiting until the later stages of the disease. Occasionally, we have mixed infections and calculous disease associated with the tubercular involvement, and this would change the clinical picture. When the ureter becomes blocked, we have the typical symptoms of renal colic, but this is the exception.

In the later stages of the disease we have chills, sweats, progressive emaciation, and frequently tubercular involvement of other organs.

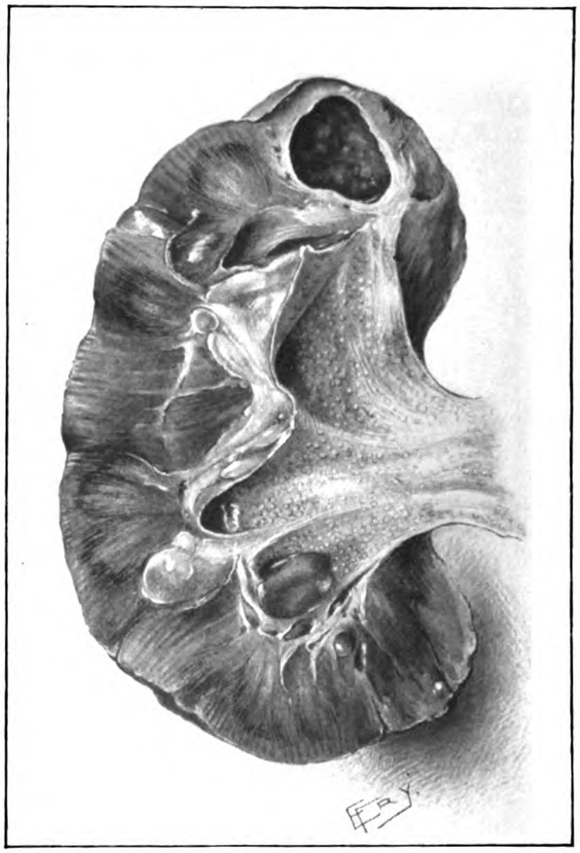


Fig. 216.—Section of a tubercular kidney showing miliary tuberculosis of the pelvis. The only symptoms which pointed to the kidney were the appearance of a moderate number of pus-cells and a small number of tubercle bacilli which were demonstrated by the ureter catheter. There were no other symptoms referable to the kidney.

Rectal or vaginal examination will frequently demonstrate a thickened sensitive section of ureter as it traverses the bladder wall. This is especially characteristic of the disease.

Bladder Symptoms.—Almost without exception, patients suffering with renal tuberculosis present themselves for relief from frequent and painful urination. Exceptionally, these symptoms are absent, but the above statement holds good for the great majority of cases. These symptoms may be due to reflex reno-ureteral causes, to non-tubercular inflammation of the bladder, or to the irritation of a tubercular disease of the bladder itself. The writer has seen a most agonizing and persistent dysuria arising from a tuber-

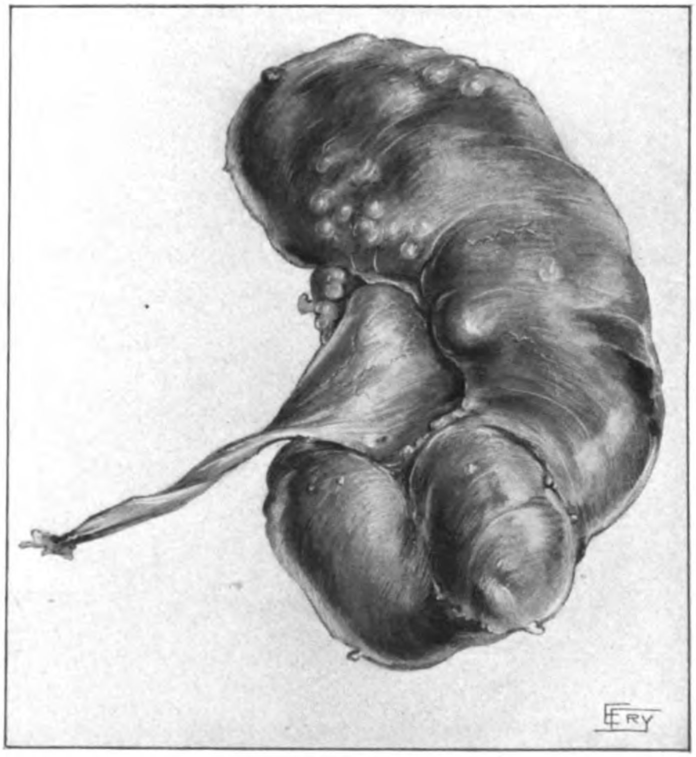


Fig. 217.—Tuberculosis of the kidney—external appearance in case presenting only bladder symptoms.

cular disease of the lower portion of the ureter without apparent involvement of the bladder wall. The most prominent symptoms are *painful and frequent urination, present both day and night.*

Urinary Symptoms.—Almost the first sign of renal disturbance is the *frequent urination.* This is a constant symptom. The urine is pale, acid in reaction, of low specific gravity, and contains albumin in proportion to the changes in the kidney and the amount of pus present.

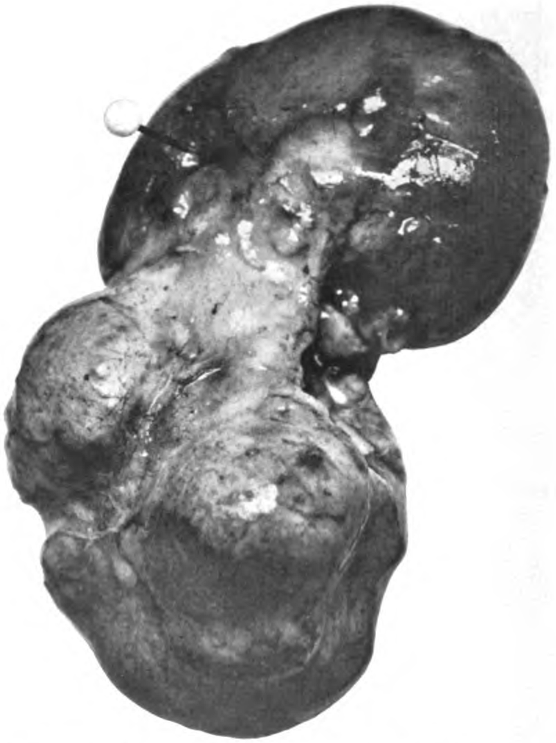
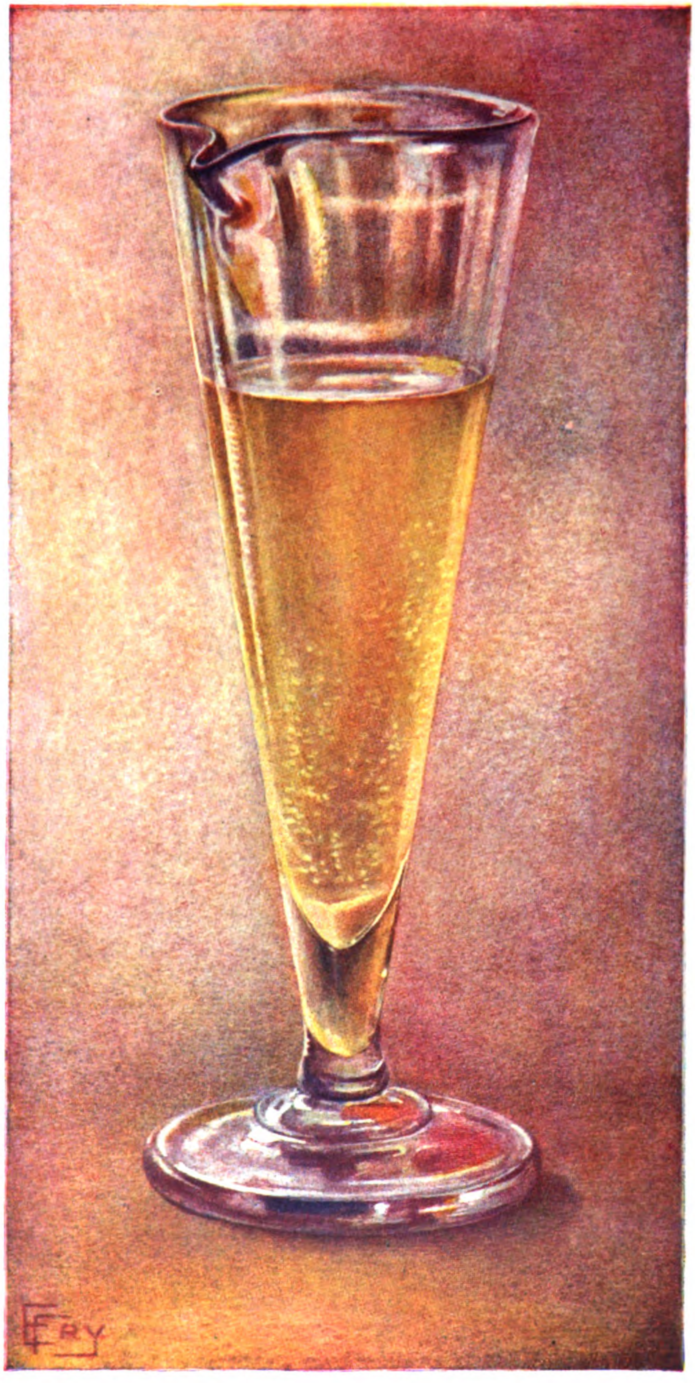


Fig. 218.—Tuberculosis of the kidney—external appearance of the kidney in case presenting only bladder symptoms.

Pyuria.—Next in importance is the constant pyuria.

PLATE X



A GLASS OF URINE OBTAINED FROM A CASE OF TUBERCULOSIS OF THE KIDNEY.

Note the heavy white sediment in the bottom of the glass, with a tenacious flocculent suspension which is characteristic of this condition.

If the urine be collected by catheter from the bladder, one will get an entirely erroneous idea of the actual amount coming from the kidney. In an advanced case, for example, the urine collected from the bladder will be thick with pus, the flocculent, whitish flakes of pus and necrotic tissue adhering to the sides of the glass container as the fluid stands, settling very slowly to the bottom of the glass (Plate X). If then, in the same case, a catheter is passed into the ureter leading from the diseased kidney, or a segregator is used, collecting the urine as quickly as it comes from the ureter opening, the specimen collected will be found to be quite different from that collected from the bladder, although only one kidney is affected. This second specimen looks almost like clear water; it is acid in reaction, of low specific gravity, and shows very little macroscopic pus. In other words, more pus often comes from the bladder, and, therefore, it is useless to try and estimate the extent of renal involvement from the amount of pus found in the bladder urine.

The character of the pus-cells varies; in some cases the cells show marked degenerative changes; in others, they are clear and the nuclei are distinct. In a majority of the cases observed by the writer the mononuclear cells have predominated, but equally typical cases with 75 per cent. to 80 per cent. polymorphonuclear cells have been observed.

Hematuria is one of the less frequent symptoms of tuberculosis of the kidney, occurring in about 25 per cent. of the cases. A few blood-cells in the urine, mixed with the pus-cells, are frequently found, especially when there is an ulcerative cystitis, but this does not constitute a hematuria. A sudden hemorrhage of greater or less extent is more frequently seen in the early stages of the disease and usually indicates an ulcerated condition of the pelvis of the kidney.

The reaction of the urine is usually acid, but, if we have a mixed infection with pyonephrosis, it may be alkaline.

Cystoscopic Examination.—The bladder, even though the mucosa is not markedly involved, is extremely intolerant of any foreign medium introduced, and therefore a general anesthetic is necessary for a complete cystoscopic examination.

The appearance of the bladder in tubercular cystitis has already been described on page 225.

The Meatus Ureteri.—It is the rule that all cases of renal tuberculosis which give rise to definite symptoms show some more or less characteristic changes in the appearance of the corresponding ureter opening or of the mucous membrane directly surrounding it. It depends, naturally, upon the stage of the disease. It has been the writer's experience that, the greater the amount of involvement at the vesical end of the ureter, the more advanced is the destruction of the kidney.

One of the most frequent findings in an early stage is an irregular area of hyperemia and swelling, either surrounding the opening or extending out from it along the trigone. It is of a dull reddish shade, not suggesting an active inflammation, but more a continued stimulation by some irritating solution. Later these areas show distinct thickening of the mucous membrane due to round-celled infiltration. The next stage is represented either by the formation of typical groups of distinct tubercles or small vesicles, or by a loss of the epithelial covering and the formation of small ulcers.

As the disease progresses, changes take place in the conformation of the opening itself. The walls of the vesical portion of the ureter become thickened and the sphincter loses its normal contracting power (Fig. 219). The entire course of the ureter through the bladder wall is plainly outlined and its distal end protrudes further into the bladder, appearing somewhat like a crater with an irregular, sometimes angular, sometimes annular, center, the opening itself being hidden in the folds of tissue. At times the orifice is seen as a rounded hole with stiff, non-contracting sphincter. When the interureteric band and the trigone become ulcerated and infiltrated, the lower end of the ureter may be distorted and the meatus considerably displaced.

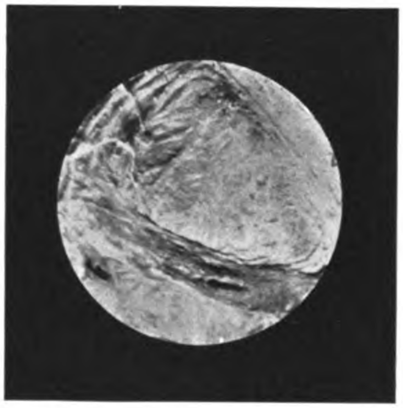


Fig. 219.—Cystoscopic picture showing ureter opening leading from a tubercular kidney. The stiff raised-up edges of the ureter ridge can be plainly seen, also the congestion without ulceration.

Again, the entire area surrounding the orifice may resemble closely granulation tissue, or the tissue may be simply congested and edematous and dotted with small areas of ecchymosis.

It should be carefully noted that the writer does not claim that these changes, as described above, take place in every case of unilateral renal tuberculosis; he would merely state that, in every case examined by him in which there were definite bladder symptoms, some inflammatory reaction was found at or surrounding the ureter opening corresponding to the diseased kidney.

It is equally true that in many cases tubercular cystitis was present and suspicious changes were found in the neighborhood of the healthy ureter opening, but in the majority of cases the most marked lesions were situated on the diseased side. If one is not proficient in ureter catheterism, or a segregator cannot be used, it is justifiable to assume that the disease is confined to the kidney which presents an inflamed, ulcerated, or distorted ureter opening. Under ordinary conditions, however, the catheterization of both ureters and the examination of the secretions from each kidney separately are always the indicated procedure.

Urinary Efflux.—This depends upon the amount of destruction and distortion which has taken place at the meatus. The amount of urine delivered to the bladder is increased, is pale in color, and is seldom sufficiently purulent to be detected by the observer.

Ureter Catheterism.—If the opening of the ureter can be found and is not strictured, the catheter can be introduced without danger. Usually one meets the greater amount of resistance in the vesical portion of the ureter. It is here that the walls are thickened and infiltrated, producing conditions unfavorable for dilatation. If the catheter passes this first portion, there is usually no difficulty in advancing it to the pelvis of the kidney. At times obstructions are met with farther along the course of the ureter, and these may be multiple and situated at any point along the ureter.

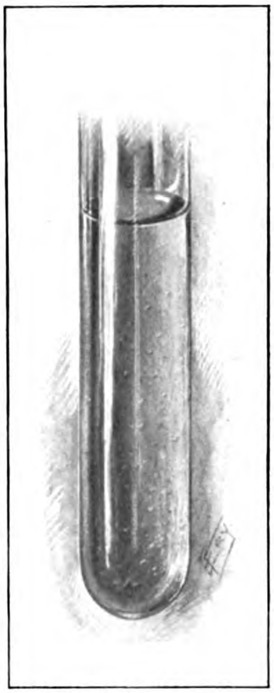


Fig. 220.—Test-tube containing urine from a tubercular kidney.

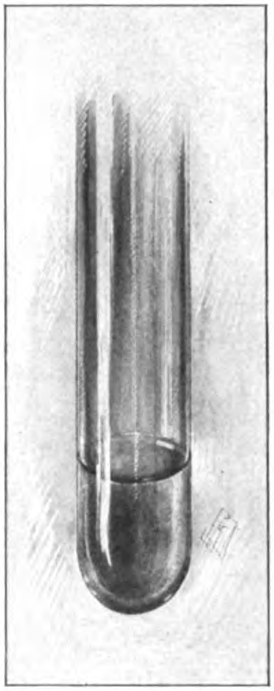


Fig. 221.—Test-tube containing urine from a normal kidney in the same patient, collected at the same time as that in Fig. 220.

There is nothing especially characteristic in the droppings from the catheter to differentiate this affection from pyogenic infections of the kidney from other causes.

Urine.—The urine from the diseased kidney is pale in color, resembling weak lemonade in appearance, acid in reaction, of low specific gravity, and usually below 1010; it always contains numerous pus-cells. In the early stages of the disease the amount is greatly in excess of that from the normal side (Figs. 220 and 221). This last statement is not applicable, however, to the advanced cases with marked destruction of the renal substance. The secretions may be considerably influenced by reflex nervous causes.

The above is only a general statement of the usual findings. The contents of the urine in each kidney vary from time to time, and for purposes of illustration we will arrange the findings in tabulated form, comparing a tubercular and non-tubercular kidney in the same patient, at an early and during the later stage of the disease.

TABLE OF COMPARISON BETWEEN THE TUBERCULAR AND NON-TUBERCULAR KIDNEY

	Tubercular Kidney		Non-tubercular Kidney	
	Early Stage	*Late Stage*	*Early Stage*	*Late Stage*
Amount....	Greatly increased	Changeable	Normal	Increased
Color......	Very pale, colorless	Turbid	Normal	Pale
Reaction ...	Acid	Neutral or alkaline	Acid	Acid
Albumin....	Trace	Heavy trace	None	Trace variable
Specific gravity...	Very low, 1002–1008	Low	Normal	Low, 1008–1012
Indigo-carmin......	Fifteen to twenty minutes, pale green	May find no reaction, or late	Dark blue in five to ten minutes	Delayed ten to twenty minutes
Phloridzin injection, 0.01 gm...	Sugar appears late; thirty to forty minutes	No reaction or only after an hour	Sugar appears in ten to fifteen minutes	Sugar appears in fifteen to twenty minutes
Animal injection ...	Positive for tuberculosis	Positive for tuberculosis	Negative	Negative
Microscopic examination	Tubercle bacilli, pus-cells, occasional blood-cells, renal cells	Tubercle bacilli; large amount of pus; rarely blood-cells, hyaline and granular casts	No bacteria; few renal epithelia	No bacteria; large amount of granular renal epithelium; few hyaline casts; few leukocytes and red blood-cells

Differential Diagnosis.—The symptoms arising from tuberculosis of the kidney may be interpreted as those due to a non-specific cystitis, other suppurative diseases of the kidney, pyelitis, nephrolithiasis, tumors, and renal varix. The disease is not easily confused with other conditions, but many mistakes are made.

The cardinal symptoms of tuberculosis of the kidney are the long-continued pyuria, which resists all local treatment of the bladder, marked polyuria, frequent and painful urination day and night, a contracted and intolerant bladder, the presence of tubercle bacilli in the urine, and the cystoscopic findings and results of ureter catheterism.

Non-tubercular Cystitis.—The onset is more acute and the condition responds more quickly to local and medicinal treatment. Medium does not clear as quickly when irrigated. Larger amounts of pus. Infecting organism can usually be demonstrated. Absence of tubercle bacilli. Alkaline urine in the chronic cases. Cystoscopic picture is characteristic.

Pyelonephritis.—Course is more acute. Inflammatory symptoms referable to the diseased kidney, with more definite pain and tenderness. Bladder symptoms not as prominent. Rapid development of septic symptoms. Bladder not as intolerant. Vesical portion of ureter not thickened. Absence of tubercular changes in the bladder. In some cases of secondary infection of a tubercular kidney the differential diagnosis is very difficult.

Renal Calculus.—The characteristic attacks of renal colic are absent, as a rule, in tuberculosis of the kidney. Blood is more constantly present in renal calculus. The bladder symptoms are transitory, unless accompanied by a pyonephrosis. Pyuria is not prominent. The x-ray and wax-tipped ureter catheter will generally serve to differentiate between renal calculus and tuberculosis of the kidney.

Tumors of the Kidney and Renal Varix.—Both of these conditions may give rise to hematuria, which may be confused with the hemorrhage occasionally seen in tuberculosis of the renal pelvis. The absence of polyuria, dysuria, pyuria, and tubercle bacilli will serve to exclude tuberculosis of the kidney.

Indications for Treatment.—If the tuberculous process is found to be unilateral, even though the bladder is extensively involved, provided the second kidney has been found to be capable of carrying on the renal functions, nephrectomy is indicated. Frequently, the tubercular disease of the bladder will heal spontaneously after removal of the diseased kidney. When one kidney is extensively involved and causes some septic symptoms, and the second kidney is only slightly diseased, as shown by the functional tests, nephrectomy may be undertaken with considerable hope of success. If the second kidney does not come up to the functional requirements, nephrotomy is indicated, with drainage of the abscess cavities of the kidney causing the septic symptoms.

X-Ray as an Aid to Diagnosis in Tuberculosis of the Kidney.—During the past two years the improvement in technic in securing radiographs of the kidney has made it possible in many cases to show the tubercular areas in a given kidney. In some of the more striking cases the shadows are very dense and resemble closely those made by calculi. As an example of these, the author presents

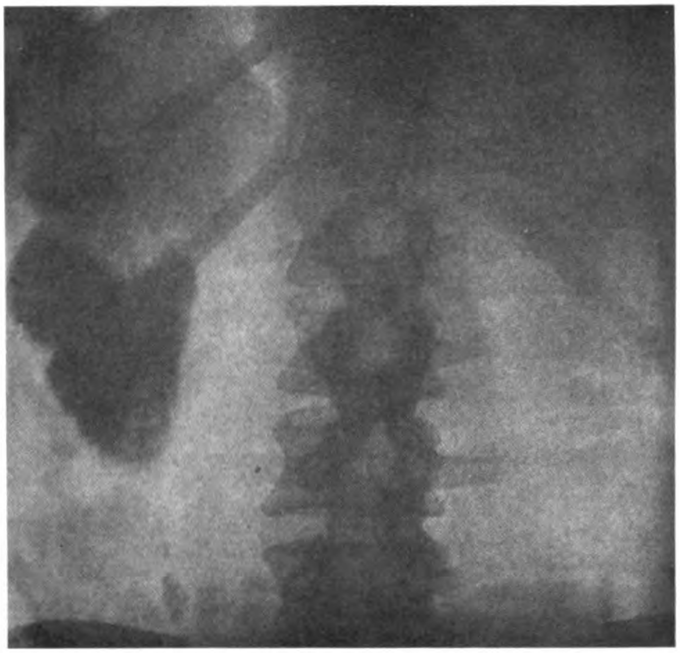


Fig. 222.—*X*-ray of a case of tuberculosis of the kidney. The dense shadows have been produced by the putty-like contents of the kidney. The concretions in the ureter at the brim of the pelvis are clearly shown.

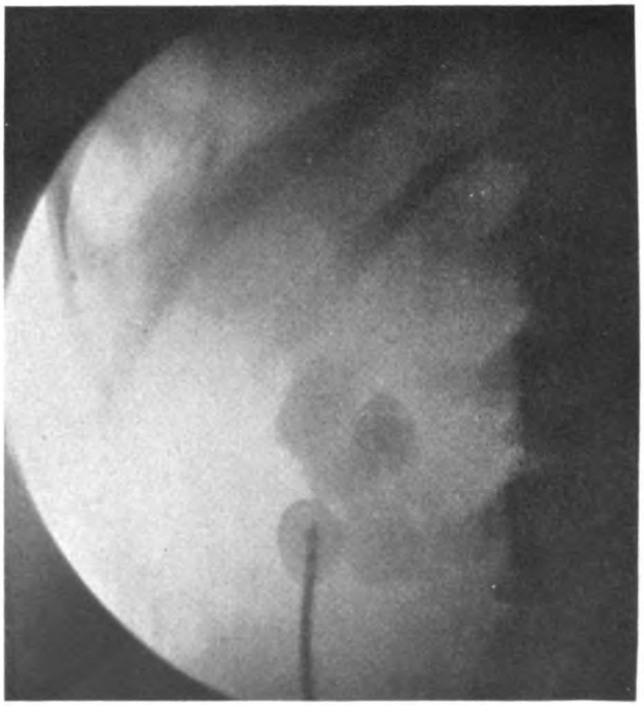


Fig. 223.—*X*-ray picture of an advanced case of tuberculosis of the kidney.

two illustrations, showing in Fig. 222 the radiograph of a kidney after twenty years or more of tubercular involvement, and Fig. 223, showing the radiograph in a case with only two years' history. The writer has been so much impressed with the radiographic findings in a number of cases that he makes it a routine part of the examination.

NOTE

Retraction of the ureteral orifice on the diseased side has been very constant in our cases (Cabot).

CHAPTER VI

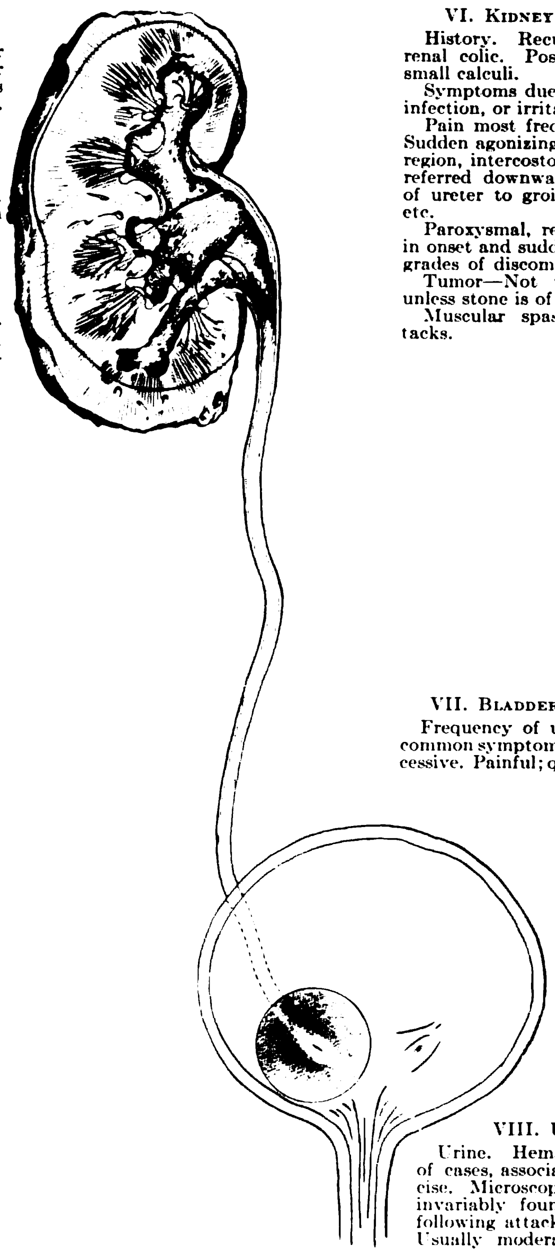
RENAL CALCULUS

RENAL calculus may be primary or secondary. The primary stones are those which develop in the kidney without previous infections. The secondary stones are those which develop as the result of a suppurative process. The uric acid, oxalate, and cystin stones are primary, and the phosphatic stones are secondary.

Calculi assume various sizes and shapes in the pelvis of the kidney. Some are large and rough, resembling pieces of coral, with irregular, antler-like projections, the body of the stone filling the pelvis of the kidney and the horns extending into the calyces. Often portions of these stones are broken off and may remain in place, articulating with the other portions of the stone and forming facets; or the loosened pieces may work down into the ureter and descend to the bladder or be arrested in the ureter. A single stone may be large enough to fill the entire pelvis of the kidney. It may be either rounded and smooth or branched and rough. It is the rule that these large single calculi do not give rise to as severe symptoms as the small, rough, movable calculi. A stone may become encysted in a calyx and, aside from the local reaction, cause no disturbance.

A stone freely movable in the renal pelvis gives rise to

RENAL CALCULUS



I. x-Ray Plate.

In 80 per cent. to 90 per cent. of cases shows shadows.

II. Ureter Catheter.

Wax tipped shows scratch marks.

III. Pelvic Distention.

Elicits characteristic renal pain. Contracted pelvis.

IV. Functional Tests.

Delayed.

V. Meatoscopy.

Unimportant. Usually some slight change on side of lesions. Variable.

VI. Kidney Symptoms.

History. Recurrent attacks of renal colic. Possibly passage of small calculi.

Symptoms due to obstruction, infection, or irritation.

Pain most frequent symptom. Sudden agonizing pain in kidney region, intercostovertebral angle, referred downward along course of ureter to groin, scrotum, leg, etc.

Paroxysmal, recurring, sudden in onset and sudden release. All grades of discomfort following.

Tumor—Not usually present unless stone is of large size.

Muscular spasms during attacks.

VII. Bladder Symptoms.

Frequency of urination a very common symptom. At times excessive. Painful; quickly subsides.

VIII. Urine.

Urine. Hematuria in 30% of cases, associated with exercise. Microscopic blood almost invariably found during and following attack of renal colic. Usually moderate number of leukocytes. In infected cases, pyuria. Uric acid and calcium oxalate crystals frequent. Renal epithelia.

Fig. 224.—Showing signs and symptoms and cystoscopic appearance of the ureter opening with renal calculus.

local trauma and invites infection. It may further become engaged at the pelvo-ureteral junction and cause complete or partial obstruction. If infection is absent, a hydronephrosis will result, the obstruction being always temporary or intermittent. As a rule, such cases become infected and a low-grade pyonephrosis results, with gradual destruction of the secreting surface of the kidney and the development of an interstitial nephritis or a pyelonephritis. All degrees of suppurative disease of the kidney are seen in these cases. In the majority, however, the destruction is not as irreparable as might be expected. The residual urine remaining in the renal pelvis soon becomes alkaline, favoring the deposit of phosphates and causing an enlargement of the stone.

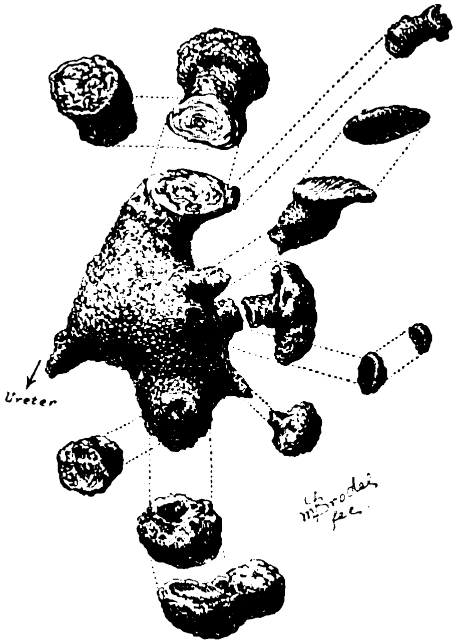


Fig. 225.—A typical branching renal calculus (Kelly).

The diagnosis must be based upon the subjective symptoms, in combination with the physical signs, urinary findings, and a cystoscopic and Röntgen-ray examination.

Symptoms.—*Subjective Symptoms.*—The patient usually gives a history of repeated attacks of renal colic or pain in the region of the affected kidney. Less than one-half of our last 100 cases have had any pain at any time which could be called colic. The pain comes on suddenly, causing intense suffering; it is sharp, tearing, or lancinating in character, with short intermissions, returning in paroxysms of greater or less severity. The pain starts, as a rule, in the region of the affected kidney, is felt most intensely in the intercosto-vertebral angle of that side, and under the free border of the ribs. It is transmitted downward along the ureter to the bladder, into the labium or scrotum, and often down the inner side of the leg to the knee. The pain is so intense that it causes marked muscular spasm on the side of the lesion, with retraction of the testis and bending of the thigh.

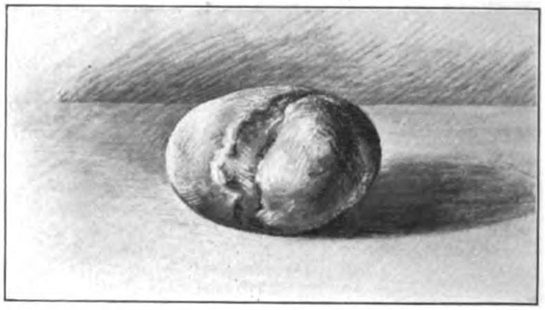


Fig. 226.—A smooth, round, renal calculus.

Accompanying Symptoms.—Nausea and vomiting generally accompany the severe attacks, but are not alarming symptoms. Pyrexia, sweating, temporary, partial, or complete anuria, and increased leukocytosis are generally present.

An attack usually lasts but a few hours, the pain subsiding suddenly, leaving the patient prostrated, but comfortable. After a period of varying length the paroxysms may recur. The pain is increased by motion, and the spells are often precipitated by some unusual or strenuous form of exercise.

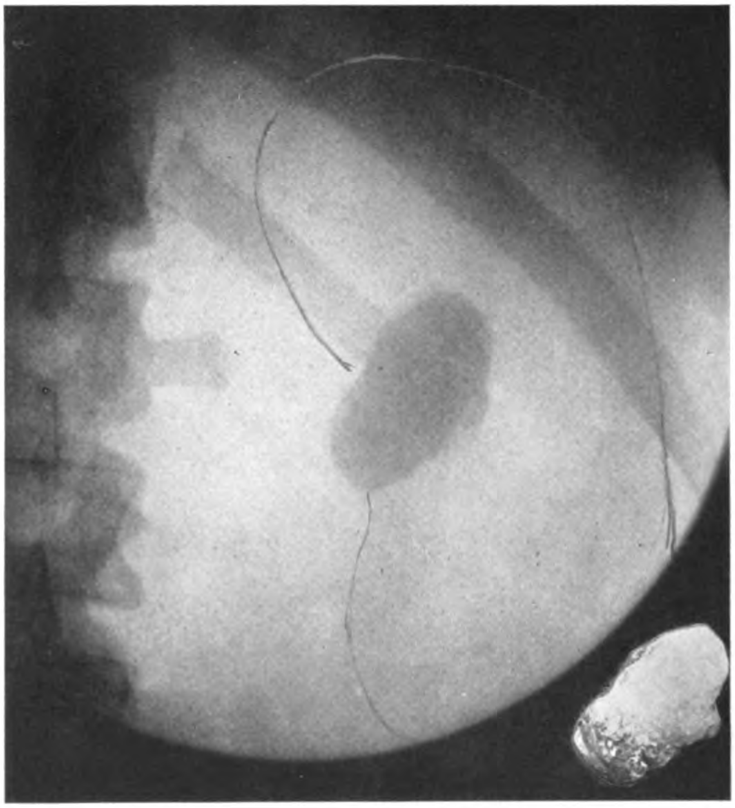


Fig. 227.—Radiograph showing a large stone occupying the renal pelvis, causing characteristic attacks of renal colic. The stone itself is shown in the lower right-hand corner.

Bladder Symptoms.—The attacks are almost always accompanied by acute bladder irritability, evidenced by painful and frequent urination.

Local Symptoms.—Renal colic is not pathognomonic of calculous disease. It occurs more frequently in this form of disease than in other kidney lesions, but it also occurs in any condition where there is a sudden blocking of the upper end of the ureter or an increase in the intracapsular tension (Johnson).* This includes tuberculosis, acute inflammation, acute congestion, subcapsular hemorrhages, and many other diseases of the kidney.

In the aseptic cases of renal calculus, unless the stone is of large size, with consequent loss of kidney substance, the patient is free from symptoms between the attacks.

If an acute infection of the kidney is engrafted upon calculous disease, the symptoms are accompanied by marked fever, septic manifestations, an increased pyuria, and a continuous pain and tenderness in the renal zone which does not subside, but may be aggravated at times. There is marked muscular spasm. In a case of pyonephrosis, secondary to renal calculus, the predominant symptoms are those of the infected renal pelvis, with possibly occasional attacks of renal colic when pieces of the stone enter the ureter or clots of inspissated pus cause temporary obstruction.

In a case of renal calculus, secondary to pyonephrosis, the same is true.

Pain in the opposite kidney has been frequently observed. In a recent case all the symptoms were referred to the sound kidney. We have also noted that between or immediately following attacks of renal colic from whatever cause the sound kidney will ache and give more trouble than the diseased one. This probably is due to the compensatory hypertrophy or acute congestion arising as a result of its unusual activity during the renal spasm of its companion, aided by a reno-pelvic nervous reflex.

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* "Surgical Diagnosis," vol. ii, p. 468.

Hematuria.—A marked hemorrhage from the kidney is the exception in cases of renal calculus. In the early stages of the disease, when an attack of renal colic indicates some change in the position of the stone, blood-cells are almost always found in the urine. The blood-cells are usually present for some time after the attack subsides. They are found less frequently in the later stages after infection has taken place.

Pyuria.—In the aseptic type the urine may be perfectly clear or contain a few leukocytes. After infection has taken place, all degrees of pyuria may be seen.

Crystals are frequently present in the urine during an attack of pain. They cannot, however, be considered as pathognomonic, as they are also present under other conditions.

Small Calculi.—An attack of renal colic may be followed by the escape of pieces of the calculus or small unbroken calculi into the bladder, establishing definitely the diagnosis.

Diagnosis.—To establish an absolute diagnosis both a cystoscopic and an *x*-ray examination should be made. In ureteral calculus cystoscopy plays the more important part, but in renal calculus the *x*-ray is, in the majority of cases, more useful.

Cystoscopy.—The question arises, how much help can we expect from the cystoscope in a case of renal calculus? The question may be answered as follows:

The cystoscope is only useful as an aid to diagnosis in these cases. The changes in the bladder are never sufficiently characteristic to be of value. The ureter catheter, with or without its waxed tip or metal point, is less useful than the Röntgen-ray, but affords valuable confirmatory evidence.

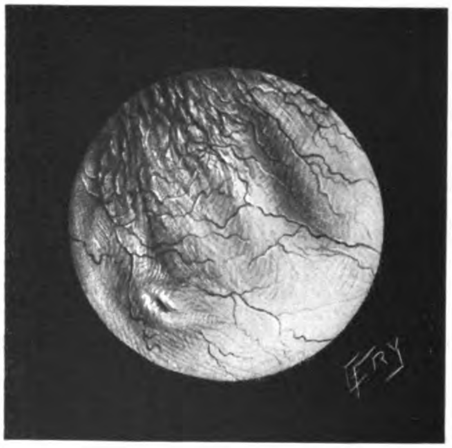

Fig. 228.—Cystoscopic picture showing a typical ureter opening corresponding to a kidney containing a renal stone in its pelvis.

The chief value of the cystoscope in renal calculus is to establish the functional activity of each kidney and, in connection with the *x*-ray, to determine the relation of the stone to the renal pelvis (Fig. 227); to determine the presence of a calculus in the ureter or bladder, and to demonstrate the condition of the bladder. We are dealing now strictly with renal calculus. Where a calculus is descending the ureter, the cystoscope is of greatest diagnostic value.

The Ureter Opening.—During the acuteness of an attack, the sphincter of the corresponding ureter opening appears tightly contracted (Fig. 228); after the attack is over, the meatus is more relaxed, congested, and, in some cases, swollen. Where a chronic pyelitis is present, the picture does not differ from that accompanying other descending infections. The bladder mucosa is not altered unless infection is present. As a rule, there is just sufficient change in the appearance of the corresponding ureter opening to determine the side on which the lesion is situated.

Urinary Efflux.—One seldom has an opportunity of observing this during an acute attack. In one case examined by the writer the diseased side showed a slow dribbling of urine, while the normal kidney was delivering urine to the bladder in strong, rapid spurts, showing the reflex stimulation.

Ureter Catheterism.—No obstruction is met with in the ureter. The writer has never felt any peculiar "grating sensation" as the catheter reached the stone in the renal pelvis. As a rule, the advance of the catheter is simply arrested as if the kidney had been reached. A wax-tipped catheter would show characteristic scratch-marks, but not as well as in the case of a ureteral stone.

The greatest value afforded the writer in renal calculus was in a case of multiple renal calculi in a fused or double kidney. A stiletted catheter was introduced and passed to the pelvis of the kidney in its normal position high up under the ribs. This portion of the kidney was entirely normal, both pelvis and parenchyma. The lower half of the kidney was studded with stones and was quite distinct from the upper portion, evidently a double pelvis with only one ureter on that side opening into the bladder. It presented an ideal opportunity for resection.

Functional Tests.—In almost all grades of renal calculus the functional activity is impaired. The degree of the disturbance depends entirely on the individual case. The tests are important in determining the indications for treatment. The disease affects equally the phloridzin, indigo-carmin, and phenolsulphonephthalein tests. The greater the amount of renal destruction, the more advanced will be the functional derangement.

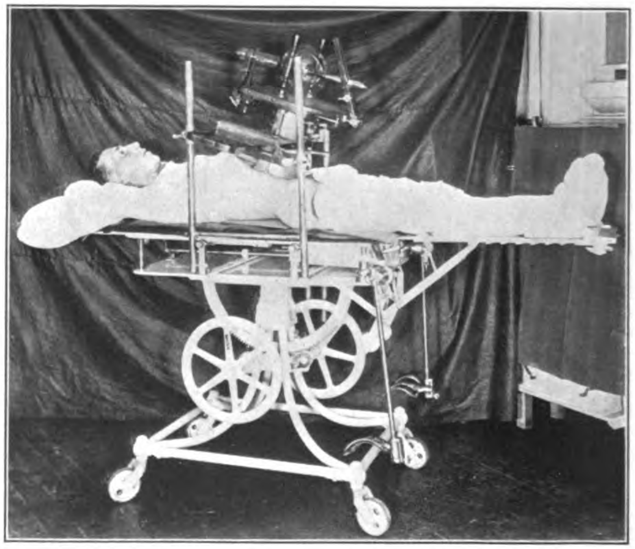

Fig. 229.—Patient in position on table with compression blend in place ready for an *x*-ray examination (Brown).

X-Ray Examination.—This is insisted upon in every case in order to determine the size, position, and number of calculi present. *We feel that a calculus which is so small as to be undetected by repeated x-ray examinations is probably small enough to pass out without surgical operation.*

Deductive Diagnosis.—Fenwick, of London, is a master in this field. He has taught us to combine the various findings and plan our operations in advance. The radiograph is our most important guide. The arrangement of the shadows, their number, position, size, denseness, etc., combined with the character of the symptoms and the chemical and microscopic contents of the urine, present the details on which we may often construct a most exact diagnosis. For example: we have learned that a number of shadows arranged along a vertical or oblique line usually indicate multiple stones in the dilated calices of a hydronephrotic kidney, and are probably contained within the shell of a kidney which should be removed. (See Fig. 232.) Or, again, that a large branched stone which casts a dense shadow may fill the pelvis and calices of the kidney without irreparable destruction of the kidney tissue. (See Fig. 230.)

From another standpoint we may be able to greatly limit our exploration of the kidney, and, basing our surgical attack upon our deductions previous to operation, remove the calculus through the renal pelvis. For example, *an oxalate stone gives one of the densest shadows on an x-ray plate.* An oxalate stone is slow in its development, is usually situated low down in the renal pelvis, and is easily removed by pyelolithotomy. Therefore, if we have a patient who has repeated attacks of renal colic, or a fixed loin pain, with occasional hematuria, with a urine that is loaded down with oxalate of calcium crystals, in the absence of bacteria, and the *x*-ray shows a round-shaped stone below the free border of the ribs, one may be fairly certain that, by a lumbar incision, a careful exposure of the kidney, and an incision of the renal pelvis on its posterior surface, the stone can be removed with little danger of a long-continued urinary fistula resulting. If, however, in a patient with the same symptoms and in whom the urinary findings are identical, we find an oval-shaped stone situated in the upper pole of the kidney, the shadow in the radiograph showing well above the free border of the ribs, it is fair to assume beforehand that the pelvis of the kidney is contracted by irritation, that the stone is situated high up within the kidney, and that it cannot always be satisfactorily exposed through the renal pelvis. Without attempting, then, in such a case to do a pyelolithotomy, a cortical incision limited in its extent will quickly and safely expose the stone and allow of its removal.

On the other hand, if the *x*-ray shows a triangular stone with the apex pointing inward or downward, in the presence of an alkaline urine, usually without hematuria and without a history of much pain or repeated colic, with an excess of phosphates in the urine, it is logical to conclude that the stone obstructing the pelvo-ureteral junction is composed of phosphates, and is the beginning of a dangerous branching stone which sooner or later will destroy the kidney itself. Such stones often have small branches which fracture easily and do not show on the *x*-ray plate. Under such conditions it is still often possible to remove the stone entirely through a restricted opening in the renal pelvis. If the stone when removed shows that a portion of the calculus has been broken off from the main mass, the remaining fragment can sometimes be removed by incising the calix, or, if necessary, by a cortical incision. At any rate, the existence of such a stone is an absolute indication for operation.

Again, *the urate stones are very frequently multiple.* On an *x*-ray plate we will sometimes find a large stone blocking the ureter opening, and below this shadow are seen indications of a number of smaller stones in the kidney substance. Such a picture would indicate a considerable destruction of renal tissue with the formation of dilated calices, in the bottom of which are contained multiple calculi which are lower down than the one at the ureteropelvic junction. Such a case might well be approached by a combined pelvo-ureteral and cortical incision, for it is practically impossible to remove all the small stones contained within a dilated calix through an incision in the renal pelvis.

Differential Diagnosis.—When we have characteristic attacks of renal colic, frequently repeated, accompanied by microscopic or macroscopic quantities of blood in the urine during and following the attack, and the presence of large numbers of calcium oxalate or uric acid crystals in the urine, and when small calculi or pieces of calculi have been previously passed, we have strong evidence of the presence of a renal calculus. When, further, the *x*-ray plate shows a distinct shadow in the kidney region, in addition to the above symptoms, the diagnosis is fairly well established.

There are, however, a number of other conditions which closely simulate the symptoms of kidney stone, especially as the characteristic symptoms are not always present.

Appendicitis, cholelithiasis, certain ovarian diseases, and the crises of tabes often simulate the attacks of pain due to a renal calculus, but they may all be differentiated by careful examination of the urine, employing the cystoscope, and the use of the x-ray.

Morris* records forty-four cases in which surgical operation was done for suspected renal stone in which the diagnosis was wrong. The findings in these cases included the following: Foci of tuberculous disease; a freely movable kidney; abscess of the kidney and suppurating cysts; solid renal or perirenal tumor or cyst; blood extravasated beneath the fibrous capsule or pent up within the cavity of the kidney; perirenal adhesions; ureteral strictures; acute engorgement of the kidney.

With our present methods of investigation the chief lesions that lead to confusion are tuberculosis of the kidney, acute pyelitis, renal tumor, vesical tumor, and renal varix.

Tuberculosis of the Kidney.—This is evidenced by the continuousness of the symptoms, the usual absence of subjective renal symptoms, the changes surrounding the ureteral opening, the great urgency and frequency of urination both day and night, and the presence of tubercle bacilli and pus in the urine.

Acute pyelitis comes on suddenly, with pain, sometimes with renal colic, in the region of one kidney. The pain tends to remain localized in the region of the affected organ. It is more continuous than that of renal calculus. There is greater swelling and tenderness of the kidney, the septic manifestations are more marked, with higher temperature, an increased leukocytosis, and with a polymorphonuclear count of over 90 per cent. There is an acute pyuria, increased frequency of urination, and an absence of blood in the urine and absence of shadow on the x-ray plate.

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* Morris: "Surgical Diseases of the Kidney and Ureter," vol. ii, p. 95.

Ureter catheterism and lavage of the renal pelvis cause a rapid subsidence of the symptoms.

Tumors of the Kidney.—A quiescent stone which gradually causes ulceration of the renal pelvis, resulting in a sudden unexplained hemorrhage, is difficult of diagnosis. But this is the exception. With tumor of the kidney the pain is less prominent, seldom, if ever, occurring in paroxysms, and is usually not evident until the growth has attained sufficient size to be palpable. Hemorrhage is a more prominent symptom. It comes on suddenly, independent of motion or exercise, is large in amount, of short duration, recurring at irregular intervals, and blood is, as a rule, entirely absent between the periods. Pyuria is absent. The functional derangement is greater in tumor formations.

Vesical Tumor.—This occurs most often near the ureter opening or along the course of the ureter through the bladder wall. The two most frequent symptoms complained of are hematuria and pain in the region of the kidney corresponding to the side on which the tumor is placed. The renal pain is entirely different in character from the usual manifestations of calculus. The cystoscope will immediately show the source of the trouble if due to vesical tumor.

Suppurative Diseases of the Kidney.—The consideration and differentiation of suppurative diseases of the kidney are given on pages 349 to 356. The symptoms, as a rule, are sufficiently characteristic to make the diagnosis by the aid of the cystoscope quite definite. Many of them are complicated by the formation of secondary calculi.

Renal Varix.—Many cases of angiomatous disease of the papillæ renales have been confused with calculous disease.

Renal varix is devoid of symptoms other than the presence of considerable blood in the urine. The hemorrhage occurs independent of exercise and is frequently more marked in the morning, after a night's rest, than later in the day. There are no subjective symptoms referable to the kidney and there is no pus or other abnormal ingredient in the urine aside from the blood. A careful consideration of the history and an *x*-ray examination will serve to differentiate renal varix from renal calculi.

Ureteral and Vesical Calculi.—For a discussion of this subject the reader is referred to the separate chapters on ureteral and vesical calculi (page 247 and page 278).

Solving the Complicated Problems in Renal Lithiasis.—Oftentimes we must go still further in our study of a given case of renal calculus. Our direct, deductive, and differential diagnoses have been completed; we know that a calculus is present; we know its position; we know, to a certain degree, the amount of damage that has been done. Then a new factor enters, for we find that the other kidney or ureter also contains a calculus. The question then arises: which side shall we attack first? How far can we safely go? To pursue this subject to its logical conclusion would involve an extensive treatise. The author will limit himself here to the presentation of a few illustrative cases which have come under his observation.

ILLUSTRATIVE CASES

CASE 1.—*Bilateral renal calculi; chief symptoms referred to left kidney owing to descent of calculi into ureter; large branched calculus filling pelvis and calices of right kidney; removal by pyelolithotomy.*—Admitted to the Pilcher Hospital

February 9, 1913. Twelve years ago ovaries were removed, together with multiple small fibroid tumors of the uterus which were supposed to cause irritability of the bladder. Ten years ago had violent attack of colic of the bladder, characterized by violent pain low down in the abdomen and inability to urinate. These symptoms gradually improved, and patient was in good health. June 15, 1912, she began to have a sense of discomfort referred to the left side and back, evidently renal; then an acute renal colic referred to the left side, which lasted for three hours, and caused much prostration; pus and blood in the urine. Following that for three or four days had similar attacks, but less severe. Now urinates every hour, night and day; is never free from desire to urinate. Paroxysms of pain start in the region of the left kidney, pass down the left side to the bladder. Need of urination every few minutes at such times. Later the pain was severe in the bladder.

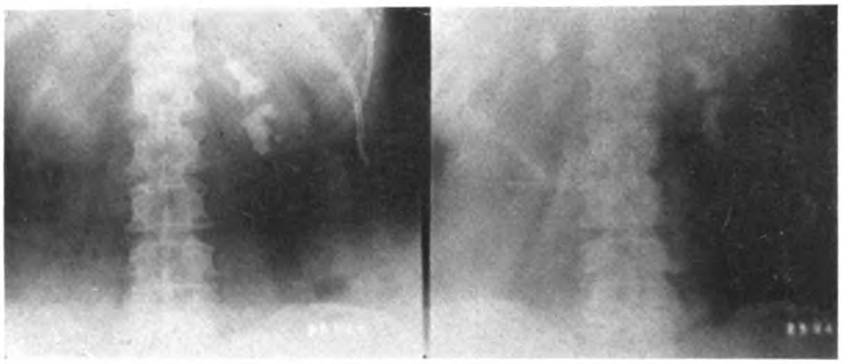


Fig. 230.—Stereoscopic x-ray plate showing calculi in Case 1. The two distinct masses represent the stones in the right kidney. The outline of the kidney can be seen and is only slightly larger than normal.

Cystoscopic examination, September, 1912, showed the bladder to be normal; no obstruction in the ureters; urine from left kidney contained blood. Examination of the bladder urine showed pus and blood to be present.

X-Ray Examination.—An x-ray examination showed left kidney clear; *an oblong stone in the left ureter near the bladder; branched stones in the right kidney.*

In the history given there was no complaint referable to the right kidney, and yet the x-ray shows in it a collection of stones which is very striking. A closer cross-examination of the patient brings out a history of previous symptoms pointing to the right kidney. These are not of recent date, but more probably deal with that period when the original stone was forming and small bits of stone or large collections of crystals were passing along the ureter (Fig. 230).

At the present time attention is drawn toward the left kidney because a stone has entered the ureter and is making its way downward to the bladder. The first attack of pain is evidenced when the stone engages at the ureteral intake. This portion of the ureter is very dilatable, and with the continued spasm of the walls of the renal pelvis and the added dilatation due to the blocking of the ureter the stone is gradually forced downward, being arrested either at the brim of the bony pelvis or, passing this, engaging at the ureterovesical junction. So we may explain the symptoms in this case. The relatively small cylindric stone with blunted ends shows clearly in the picture.

The right kidney appears perfectly normal in conformation, its outline smooth and regular. It contains three distinct calculi and possibly a fourth, which is overshadowed by the lower mass. Naturally the kidney is enlarged, but the shadowgraph would indicate no area of destruction, its density being equal throughout. Also, if there was obstruction of the ureter at its inlet, a hydronephrosis would result and this would be shown by irregularities in the outline of the kidney. Studying the shadowgraph, therefore, we conclude that the right kidney is in its normal position, that its pedicle is not very long, that its pelvis is filled with a mass of calculi, and that these lie well embedded in the pelvis and do not move downward and engage in the ureteral inlet.

Second, that there is a small cylindric stone in the left ureter at the point where the ureter enters the bladder. The fact that the symptoms referable to the left kidney have abated is significant of the fact that the urine is passing the obstruction at present; further, that the stone may be removed in two ways—(1) by the vaginal route, and (2) by the transperitoneal route.

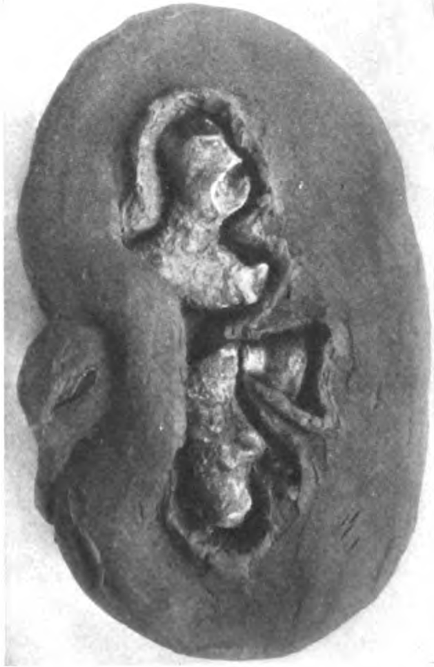


Fig. 231.—Photograph of a reconstructed model, showing the stones in place after their removal from the kidney. A typical pyelolithotomy was done and through the small incision in the renal pelvis, as indicated in the photograph, the stones were successfully removed from the kidney without any injury to the tissue itself.

The indication in the present case is to remove the obstruction from the left ureter; later, to perform a nephrolithotomy on the right kidney.

This indication is emphasized because the functional activity of the right kidney is nearly normal and that of the left kidney is considerably below normal.

On October 9, 1912, radiographs still showed the stone present in the left ureter and the large calculi in the right kidney.

In January, 1913, the patient had another attack of discomfort in the region of the left kidney This stopped suddenly, and after that time the patient felt much better. February 8, 1913, another set of pictures was taken. The plates showed two large calculi branching into the calices of the right kidney, and a third calculus, much smaller, opposite the lower one of these two, the lower of the two larger calculi having two projections which extended anteriorly. There were, in addition, small calculous patches in the neighborhood of the upper one of the larger stones. *The shadow of the calculus shown in the left ureter at the first examination made in December had disappeared, and it was thought that the calculus had passed.*

Functional test made February 10, 1913, showed both kidneys to be normal in function. Bladder urine, 1.016; strongly alkaline; moderate amount of albumin; traces of blood and large quantities of muco-pus with triple phosphate crystals. Urine from right kidney contained pus and blood. Urine from left kidney some blood, no pus, and an excess of large lymphocytes.

The problem, then, had reduced itself to the condition of the large branched stone in the right kidney (Fig. 230). We did not feel that pyelolithotomy was impossible even in the presence of such large calculi as these, and we therefore determined to try it in this case.

Operation.—Pyelolithotomy of right kidney, February 11, 1913, by Dr. P. M. Pilcher. The usual operation was made for exposing the right kidney. By careful manipulation it was possible to remove the calculi from the kidney through an opening in the renal pelvis without in any way injuring the renal parenchyma.

Post-operative History.—There was no leakage from the wound until about four days after the operation, at which time some urine leaked through the wound. This continued for about two weeks. Patient made a perfect operative recovery, and the wound healed entirely in about three weeks.

After-history.—About three months after the operation patient had some renal colic on the right side, which passed off quickly. Since that time she has been perfectly well and has had no further symptoms of calculous disease on either side.

A model was made of the kidney after the operations with the stones in place, showing the opening in the pelvis through which the stones were extracted (Fig. 231). This case demonstrates that the operation of pyelolithotomy may be practical, even with a large branched stone.

CASE 2.—*Hematuria; Multiple Renal Calculi in Both Kidneys; Pyonephrosis of Both Kidneys.*—Admitted to the Pilcher Hospital March 14, 1913. Patient referred to us by Dr. Weadon, of Bridgeport, Conn. She presented herself suffering from continued and exhausting hematuria, with frequent urination and a very marked pyuria with occasional attacks of severe renal colic on both sides. Thirteen years ago she was delivered of a child. Since that time she has suffered from three miscarriages. Following her child's birth she was in poor health for some time—headaches, distress in the back, general malaise. Ten years ago she was very sick, had chills, fever, and pain in the region of the right kidney. Since that time she has had more or less backache about the level of the second lumbar vertebra on both sides. Suffers from headaches, nausea, in the morning a general feeling of being only half well. Periods, etc., normal. Some years ago an operation was done in the right lumbar region to expose the kidney, but no disease was proved at that time. She had been under treatment for months for supposed uterine trouble. Cystoscopic examination disclosed a fairly normal bladder without any distinct areas of inflammation. The right ureter was catheterized and urine containing a large amount of pus was obtained from the right kidney. The left ureter was catheterized and some urine containing less pus than that from the right kidney was obtained. There were emitted, however, from the left ureter opening large clouds of thick mucus. While the catheter was in place, the mucus oozed out by the side of the catheter into the bladder. The bladder capacity was more than 12 ounces, and there were no lesions suggestive of tuberculosis; each kidney was found to be functionating equally. The right kidney was secreting a relatively large amount of pus and the left kidney a small amount. estimated at five times the amount of pus coming from the right kidney as from the left. Bacteriologic examination of the pus from both kidneys showed a pure culture of Bacillus pyocyaneus. A vaccine was made from these cultures. Each kidney pelvis was drained and a dram of 5 per cent. argyrol was injected. *Phthalein test was made of the whole urine, and it was found that a very small per cent. of the phthalein was excreted in the first hour—too little to be estimated.* Methylene-blue was also used, and only a very slight amount was excreted by both kidneys, in twenty-four hours.

X-ray pictures were taken and showed that the pelvis of each kidney was blocked by a large wedge-shaped stone. A smaller stone was in the lower pole of the left kidney, and there was also one in the upper pole near the spine, the stone in the right kidney being the larger and the stone in the left kidney being half that size. The outline of the left kidney showed it to be fairly normal in size, its upper pole being occupied by a small round calculus and its lower pole by a collection of concretions which formed a calculus of considerable size. The right kidney was seen to be very greatly enlarged, being twice as large as the left kidney, and beside the large stones at the outlet of the pelvis there were two smaller stones in the calices in the upper half of the kidney and a collection of concretions and small trash in the lower pole of the kidney (Figs. 232 and 233). The problem, then, which presented itself was primarily one of obstruction at the pelvic outlet of both kidneys, with advanced destruction of the secreting tissues of both kidneys. However, as long as there was an obstruction at the pelvic outlet it would be improbable that any improvement would be possible, therefore it was decided to relieve the obstruction at the pelvis of the more normal kidney, believing that, if this could be

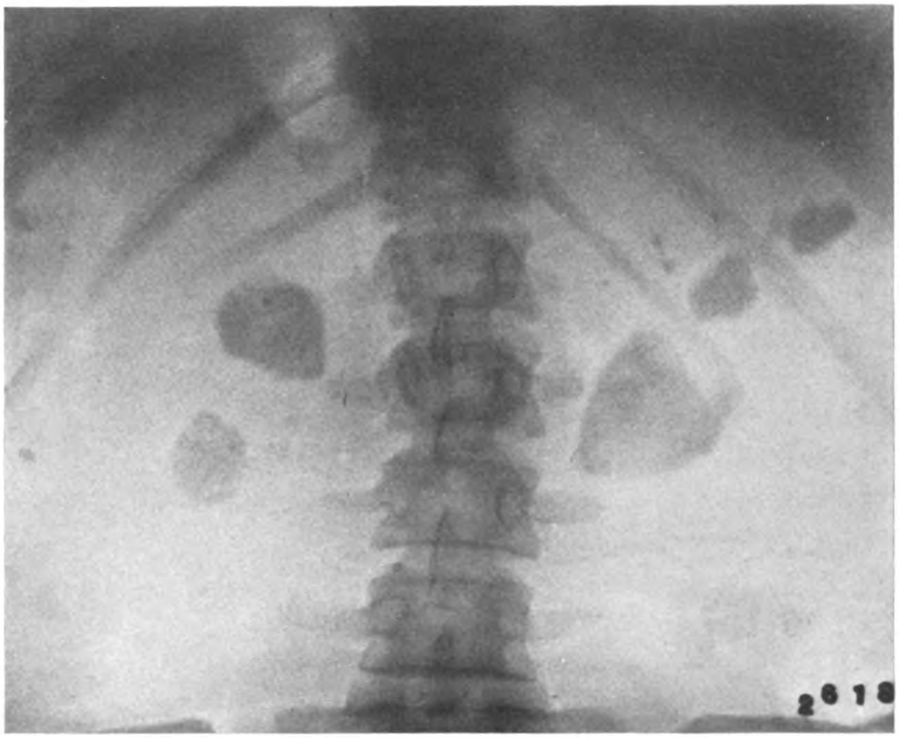


Fig. 232.—*X*-ray plate of kidneys in Case 2. In the left kidney are seen three masses—one at the pelvic outlet, one in the lower pole, and one in the upper pole. In the right kidney region are seen a mass of calculi, the largest one of which occupies the pelvic outlet. It will be seen by comparing this stone with the vertebra that it is of enormous proportions. By referring to Fig. 233, the stereoscopic picture, the relatively larger size of the kidneys can be seen.

accomplished safely, the left kidney would re-establish its normal functions to a considerable degree, and at some later date a similar operation might be performed upon the right kidney. It was felt that if no attempt was made to relieve the obstruction in the right kidney it might result in a complete disorganization of that kidney, while the chances of safely removing the obstruction and stone of the left kidney were far greater, and, if only one operation could be done, the best operation was the relief of this obstruction on the left side; therefore, under ether anesthesia the operation was undertaken.

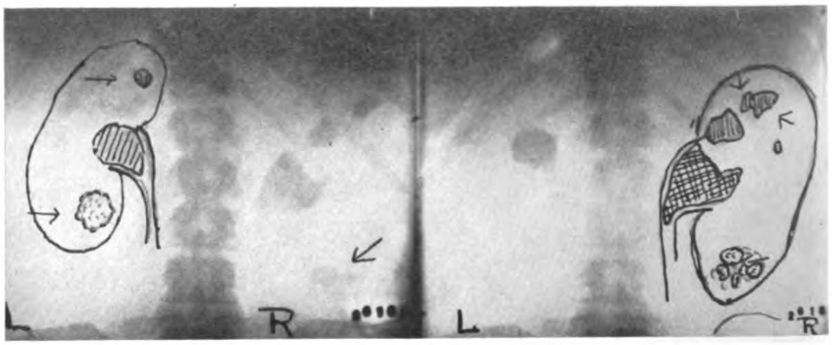


Fig. 233.—Stereoscopic *x*-ray of the kidney regions in Case 2. The writer has outlined in ink his interpretation of the position of the various stones in the kidney. On the left side the pelvic outlet is occupied by a large stone. In the lower pole of the kidney is seen an irregular concretion, and judging by its relative circumference and the very slight shadow which it casts on the *x*-ray plate, it is estimated that this mass is made up of calcareous deposits on the wall of a dilated portion of the kidney and is not a free stone. The same is true of the single shadow in the upper pole of the kidney. The right kidney is seen to be enormously dilated and its pelvis blocked by an enormous stone with a series of stones in the upper pole, and the lower portion of the kidney is occupied by a mass of concretions evidently attached to the pelvic wall of a large hydronephrotic sac. The problem in this case was to relieve the patient from advancing uremia and a continuous exhausting hematuria. It was decided to do a pyelolithotomy of the left kidney, which was successfully carried out.

Operation.—Pyelolithotomy, March 22, 1913, by Dr. P. M. Pilcher.

The usual straight lumbar incision was made with the arm extending forward along the crest of the ilium. The kidney was exposed and found to be densely adherent to the surrounding tissue, especially at its upper pole. The area at the junction of the middle third of the kidney showed marked evidences of destruction of the kidney tissue within the organ, and there was great danger of tearing off the upper pole of the kidney. With considerable difficulty the kidney was freed and its posterior surface brought up into the wound, the pelvic outlet exposed, the pelvis incised, and a large stone removed from the kidney pelvis without injury to the kidney tissue. The stone was as large as an English walnut. The opening in the pelvis was sutured with silverized catgut suture. Kidney replaced; cigarette drain to pelvis and rubber tissue to the lower pole. Wound closed around these drains. Patient stood the operation well. During the first twenty-four hours she passed about 45 ounces of urine.

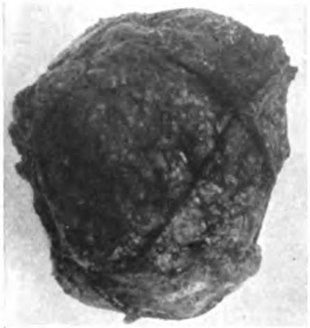


Fig. 234.—Showing a stone which was removed from the pelvis of the left kidney (Fig. 233). This calculus was made up of phosphates and uric acid crystals, and was crushed easily in removing it so that its shape is somewhat faulty.

Further History.—There was no leakage from the wound in the pelvis and the incision healed by primary union, excepting at the points where the drains led out. After the first five days of satisfactory post-operative course there were evidences of renal insufficiency. She developed a gastric type of uremia, evidenced by frequent uncontrollable vomiting and a gradually decreasing amount of urine excretion. This continued until death supervened twelve days after the operation. There were none of the ordinary evidences of uremia other than the vomiting and the suppression of urine.

In considering the case afterward we still felt justified in attempting some relief to the patient, although we were unsuccessful. In the first place, she was losing large quantities of blood and was suffering both from her frequency of urination and from pain. She was practically an invalid. At the same time the evidence which was presented showed us that both kidneys were very far below par, both in responding to the phenolphthalein test and the methylene-blue test. After removal of the stone from the pelvis the reaction of the patient was all that could be asked. She felt well, passed a normal amount of urine, and was free from fever. However, after a few days the secretion of the kidneys failed and the patient died of renal insufficiency.

The history and findings in these two complicated cases are given to illustrate the application of our diagnostic methods in choosing the proper method of treatment.

CHAPTER VII

TUMORS OF THE KIDNEY

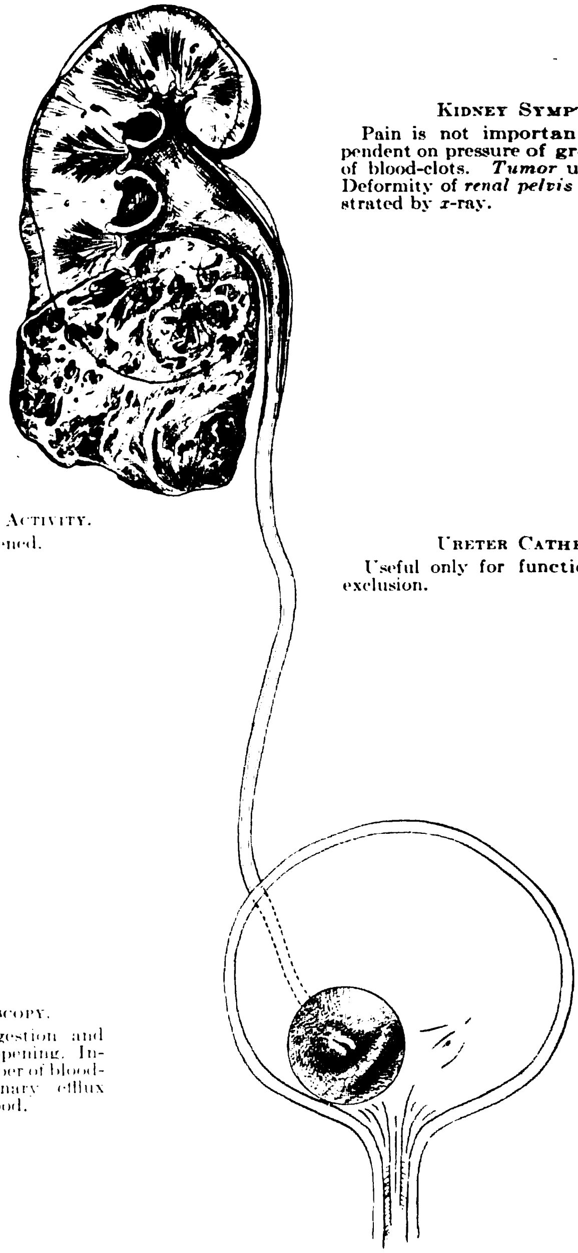
PRIMARY tumors of the kidney are almost always unilateral. From the standpoint of the diagnostician it is immaterial whether the neoplasm originates from the parenchyma of the kidney or from adrenal rest-cells; his chief object is to discover the presence of a tumor at the earliest period of its development, to determine its characteristics, as far as possible, and to estimate the value of operative interference in a given case. Metastatic tumor-growths in the kidney are frequent, but do not occur usually until the primary growth is far advanced. Renal growths complicated by other conditions, such as calculi, hydronephrosis, and pyelitis are not uncommon.

TYPES

Carcinoma of the kidney is a comparatively rare condition and is seldom primary. It is seen mostly in the aged.

Sarcoma of the kidney is more frequent and occurs almost exclusively in children and persons under thirty years of age.

Hypernephroma is by far the most frequent form of renal tumor. In the writer's own series of cases it comprises about 80 per cent. of the malignant growths of the



Constitutional Symptoms.
Usually cachexia. Irregular fever and gastro-intestinal symptoms with hypernephroma.

Kidney Symptoms.
Pain is not important. Usually dependent on pressure of growth or passage of blood-clots. *Tumor* usually palpable. Deformity of *renal pelvis* can be demonstrated by *x*-ray.

Functional Activity.
Always lessened.

Ureter Catheter.
Useful only for functional tests and exclusion.

Bladder Symptoms.
None except those due to passing clots of blood.

Meatoscopy.
Slight congestion and deformity of opening. Increase in number of blood-vessels. Urinary efflux may show blood.

Fig. 235.—Showing signs and symptoms and cystoscopic appearance of the ureter opening in a case of tumor of the kidney.

kidney. It is slow of growth; occasionally it gives rise to hematuria.

Papilloma of the renal pelvis is very infrequently met with.

Symptoms.—The first symptoms noticed vary with the individual case. Some form of dull pain localized in the renal zone is a frequent complaint. An unexplained general weakness and steady loss of weight, with cachexia, may call for the first examination of the patient. The occurrence of a sudden hematuria often is the first symptom to attract attention. The accidental discovery of a mass in the renal zone is less frequent. Various other symptoms, such as vomiting, jaundice, diarrhea, and fever, are limited usually to the cases of hypernephroma.

Tumor.—The only constant symptom of renal neoplasm is the presence of a tumor, which usually is palpable, but may be so deeply situated as not to be appreciable. Usually the tumor does not give rise to marked subjective symptoms until it has reached considerable size.

Pain is occasionally the first symptom. It varies from a dull ache in the lumbar region to a sharp lancinating pain which shoots downward to the bladder. It is seldom colicky in character. In the writer's own experience, it is a very unsatisfactory and unreliable symptom.

Hematuria is so variable a quality that no dependence can be placed on it. Statistics of different writers give the percentage of its occurrence in their personal cases as varying from 5 per cent. to 95 per cent. The simple fact remains that when a sudden unexplained hematuria takes place, tumor of the kidney must be thought of as a possible cause.

Cachexia, in advanced cases, always is present. If present in hypernephroma, it usually indicates an extension of the disease beyond the kidney.

Constitutional symptoms are not marked until the growth has reached an advanced stage. When a hypernephroma has developed metastatic foci, the symptoms are frequently very marked. In certain cases the writer has observed a very irregular fever, simulating an intermittent malarial fever, with chills, fever, and sweating, uninfluenced by quinin. The condition is temporarily influenced by removal of the primary focus.

Urinary symptoms are variable. Usually there is very little disturbance with urination, the only abnormality being the hematuria with the mechanical difficulty due to blood-clots.

Cystoscopy.—Cystoscopy will aid in a number of ways, especially in establishing the identity of a tumor in the renal zone. Frequently, there occur growths overlying the kidney, but not associated with it. A stiletted catheter in the ureter, and a wire on the abdomen outlining the growth may serve to differentiate the two on an *x*-ray plate. The bladder is normal. Secondary growths are rarely seen.

Examination of the ureter openings will often show some change in the ureter opening corresponding to the diseased kidney. There is usually a slight congestion and irregularity of the opening, and the surrounding mucous membrane is richer in blood-vessels, which frequently seem to enter the ureter. (See Plate VI, p. 214.)

Urinary Efflux.—If there is an active hemorrhage from the kidney, the blood will be seen issuing from the meatus in characteristic spurts. In malignant disease there is a greater tendency for oozing to continue from the ureter opening between the normal periods of urinary efflux.

Ureter Catheterism.—Examination of urine obtained from the kidney in such cases is not of much value excepting to determine the functional activity of the kidney. Almost invariably the functional activity of a neoplastic kidney is diminished. This is a point of importance in differentiating between a simple renal varix and a new-growth without palpable tumor; in renal varix the functional activity is not relatively altered. The finding of blood alone in a catheterized specimen from one or the other kidney should never be accepted as indicating a lesion of the kidney or ureter.

Deformity of the Renal Pelvis.—Braasch has shown by *x*-ray plates that the amount and character of the deformity of the renal pelvis can be determined with accuracy.

Differential Diagnosis.—The diagnosis of renal tumor is usually made by exclusion. Many forms of renal disease are associated with enlargement of that organ, and most of them are accompanied by definite urinary changes. It is the early stage of neoplastic disease which is difficult to diagnosticate. It will always be difficult to exclude tumor as a cause of any sudden, symptomless, renal hematuria. Fortunately, nearly all the confusing lesions call for surgical treatment, and our chief concern in the interests of the patient is to determine the functional activity of the second kidney.

Tuberculosis of the Kidney.—The positive findings of pus and tubercle bacilli in the urine, the increased frequency of urination associated with pain, and the typical cystoscopic findings will serve to differentiate the two.

Renal Calculus.—The *x*-ray picture, the more frequent attacks of renal colic, the absence of renal enlargement, and the usual presence of leukocytes in the urine are characteristic of calculous disease.

Renal Varix.—It is difficult to differentiate the symptoms of the early stage of a malignant growth of the renal pelvis and renal varix. The only active symptom of renal varix is hematuria. It is long continued, often covering a period of years, with intermissions of months and even years between the attacks of hematuria. There is frequently an associated anemia, but never the cachexia of malignant disease. The surest method of diagnosis is by operation and exposing the kidney.

Hydronephrosis.—Hydronephrosis may be caused by a tumor of the renal pelvis. If so, the two cannot be differentiated. Ordinarily, hydronephrosis is intermittent in type; tumefaction is palpable in about 33 per cent. of the cases. The intermittent attacks of colic, taken together with the cystoscopic findings, the measurement of the renal pelvis, the constant microscopic pus in the urine, and absence of blood, will serve to differentiate hydronephrosis from renal tumor.

Suppurative diseases of the kidney are characterized by a persistent pyuria and typical cystoscopic findings.

Indications for Treatment.—If a malignant growth of the kidney has been diagnosticated, its character does not materially alter the form of treatment. Eight out of every ten cases, in adults, will be found to be hypernephroma.

If we study carefully the distribution of these tumors, we will be impressed with the frequent recurrence of the growth in the second kidney. Also, statistics show an alarming mortality following nephrectomy for renal tumor; the best authorities place it between 40 per cent. and 50 per cent. following operation. Therefore it is especially important to estimate the functional activity of both kidneys before any operation is undertaken. If the second kidney is functionating below normal, it is safe to assume that any operation will be useless and probably fatal.

ILLUSTRATIVE CASE

CASE.—Referred by Dr. Flannery. Patient, a woman, aged sixty-eight. Nine years ago she was operated on and a large fibroid uterus was removed. The patient was well from that time until eight months before the examination, when her general strength was noted to be failing. On January 1, 1910, she suffered from a sudden hematuria which came on without symptoms, except an increased frequency of urination. This lasted but a few hours; then the urine remained clear for a week. At the end of that time there was another sudden appearance of hematuria without symptoms.

Examination revealed a tumor occupying the position of an enlarged and slightly prolapsed right kidney. Cystoscopic examination showed the bladder to be normal. The right ureter opening was slightly congested and irregular.

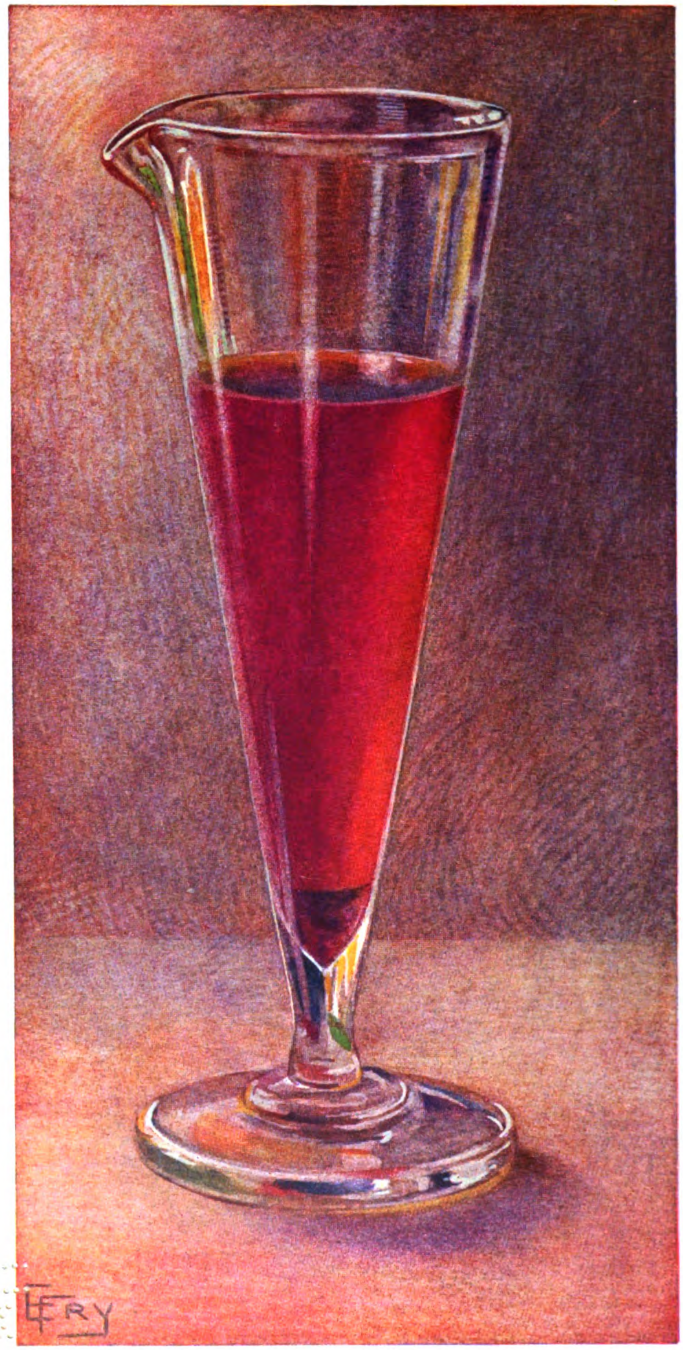
Functional Test of the Two Kidneys: Passed catheters to the pelvis of each kidney and fifteen minims of phenolsulphonephthalein were injected into the buttock. No urine was obtained from the right side, due, probably, to reflex anuria. The urine from the left kidney flowed very slowly and a typical reaction did not appear in the urine for thirteen minutes after injection of the drug. In a normal, functionating kidney this should take place in from seven to twelve minutes. It demonstrated, therefore, that not only was the right kidney diseased, but that the left kidney was also below par. During the next twenty-four hours only seventeen ounces of urine were passed from the bladder, which bore out the above conclusion.

Three days later a second functional test was made, using indigo-carmin. Only a faint greenish color appeared from the left kidney twenty-five minutes after the injection. From the right side the color appeared later.

A diagnosis of hypernephroma of the right kidney was made. No operation was advised, inasmuch as the left kidney was functionally below the standard.

The patient returned to her home and died six weeks later in a state of coma.

PLATE XI



A Glass of Bloody Urine Obtained from a Case of Renal Hematuria.
This is the characteristic appearance of the bladder urine in a case of severe renal hemorrhage, but it is not pathognomonic.

CHAPTER VIII

HEMORRHAGIC DISEASES OF THE KIDNEY

THE cystoscope is most useful in diagnosticating the source of a hematuria. By its use we are able to exclude the bladder as the source of hemorrhage and, further, to locate the particular renal pelvis from which the bleeding comes. As already described in the previous chapter, it is possible to demonstrate the source of a hematuria, even after the bleeding has stopped, by estimating the functional activity of each kidney.

Causes of Renal Hemorrhage.—Renal hemorrhage may result from trauma, or from the ingestion of certain drugs and foodstuffs; it occurs as a complication of general septic infections, or may be due to a definite pathologic lesion in the kidney itself. If due to anything which is taken by mouth or hypodermic injection, the diagnosis is easily established.

Determining the Source of the Hemorrhage.—The older methods of determining the source of hematuria from the color of the urine, the time of the appearance of blood in the urine passed, and the shape of the clot, are all unreliable, and, since the introduction of the cystoscope, do not need to be depended upon. Important facts may, however, be learned from irrigating the bladder. If there is a hemorrhage taking place and repeated washings of the bladder do not clear up the medium sufficiently to allow an inspection of the interior of the bladder, the hemorrhage is probably of bladder origin. If the fluid returns clear after one or two washings, the bleeding is probably from the kidney.

By Microscopic Examination of the Urine.—The appearance of numerous hyaline and granular casts, mixed with blood-cells, suggests renal origin of the hematuria. Numerous crystals in the urine lead one to suspect a stone. Tubercle bacilli, when found, are pathognomonic. The finding of the eggs of the Bilharzia is suggestive of bladder origin.

By Cystoscopic Examination.—The difficulties of making a satisfactory examination in the presence of hemorrhage have already been mentioned. Prolonged rest, allowing only a small amount of fluid, the exhibition of sedatives and ergot, may diminish the bleeding. If the bleeding is of bladder origin, great care must be used in irrigating. It is most important that the bladder should never be emptied completely, and only small amounts of fluid be used, injecting and withdrawing it slowly. If possible, one should not irrigate more than once; then one should attempt to make the examination. If the vesical neck or prostate is the source of the bleeding, examine the base of the bladder first and then the trigone. Bleeding ulcerations, tumors, and foreign bodies can be quickly detected, but the most confusing problem is to decide between the bleeding from an inflamed or ulcerated area near a ureter opening and bleeding actually coming from the ureter. Blood will sometimes settle slowly and almost invisibly over a ureter opening, only to become evident as the urine swirls from the ureter and mixes with it. The mere contraction of the sphincter ureterica may produce the bleeding.

When inflammation of the bladder is not present, the recognition of blood spurting and oozing from a ureter mouth is unmistakable. With each contraction of the ureter a swirl of bloody urine is ejected into the bladder, and the source of the hemorrhage is established.

It happens frequently, however, that at the time of examination no blood can be detected in the urinary efflux, either due to the temporary arrest of the bleeding or to the small amount mixed with the urine. In such cases there are generally characteristic appearances in the ureter mouths which attract attention. In renal varix and in renal tumors these may be very slight. There is usually a slight blush to the tissues, an increase in the number of vessels crossing the lips of the opening, or a few scattered vesicles, or the mucous membrane may be slightly stained with blood-pigment. In renal tumor there may be a puffiness surrounding the opening, giving it the appearance of pouting lips, with increase in the number of vessels surrounding the opening. If the renal pelvis is dilated, the orifice may appear darkly congested. Stone in the kidney pelvis does not usually cause much change in the ureteral opening, but the spasmodic contractions of the sphincter are more frequent. Tubercular disease of the kidney usually produces characteristic changes which are described elsewhere (page 315).

PAINLESS HEMATURIA

The most frequent causes for painless hematuria of renal origin are acute and chronic nephritis, renal varix, and villous papilloma of the renal pelvis. It is a well-recognized fact, also, that calculous disease of the kidney, renal tuberculosis, and acute congestion of the kidney may give rise to symptomless hematuria. The methods of differentiating these latter conditions from the first three mentioned will be taken up later.

I. ACUTE AND CHRONIC NEPHRITIS

In reviewing the cases of symptomless hematuria of obscure origin which have come under his personal observation, the writer has found that many of them have been due to some form of diffuse non-suppurative inflammation of the kidney.

Acute Nephritis.—The acute inflammations of the kidney which are the result of the ingestion of poisons, such as cantharides and potassium chlorate, and those which accompany the more acute infectious diseases, and the congestion resulting from extensive burns of the body, are productive of an intense form of nephritis, accompanied by hematuria. The usual symptoms are increased frequency of urination with a diminished amount of urine, a high specific gravity, a moderate amount of albumin, hyaline casts, degenerating renal epithelium, and red blood-cells. The absolute quantity of blood varies from a microscopic quantity to an amount sufficient to give the urine a bright red color.

Chronic Nephritis.—There are two forms of chronic nephritis in which hematuria is apt to occur:

First, *the diffuse, chronic parenchymatous nephritis*, which is frequently accompanied by paroxysmal attacks of severe hematuria. The amount of urine is diminished, the specific gravity is low, and there is a large amount of albumin, many hyaline and granular casts, many red blood-cells and leukocytes, and frequently blood-casts and epithelial casts. If a hematuria is present with the urinary findings just described, we may be fairly sure that the bleeding is caused by the nephritis, although the cause of the nephritis may be due to some other lesion of the kidney.

The second form of non-suppurative, parenchymatous disease of the kidney in which we find alarming hemorrhages is the *contracted and arteriosclerotic kidney.* In this form of nephritis the amount of urine is increased; it is of low specific gravity and contains a little albumin. The hemorrhage may take place into any part of the kidney, and in one case of the writer's the blood ruptured through the capsule and formed a perinephritic hematoma.

ILLUSTRATIVE CASES

CASE 1.—*Bilateral Renal Hematuria.—Chronic Diffuse Nephritis.*—A woman, fifty-five years of age, was referred to the writer by Dr. Louria. Her only symptom was the appearance of blood in the urine, evenly mixed with it. No clots. There were absolutely no other subjective symptoms. The urine contained albumin and hyaline and granular casts. Specific gravity, 1015.

Cystoscopic examination showed bloody urine coming from both ureter openings. The diagnosis in this case was simple enough, and the bleeding, which was continuous and at no time alarming, quickly subsided under proper antinephritic treatment. It is to be noted in passing that in this case there was no sudden increase in the bleeding at any time and no clots were present, showing an even distribution of the blood-cells. The condition was not affected by exercise.

Case 2.—*Unilateral Renal Hemorrhage. Interstitial and Parenchymatous Nephritis. Arteriosclerosis of Kidney.*—Patient, male, aged thirty-nine; Russian. No previous history of rheumatism, tuberculosis, or hemophilia. Married fifteen years; six children, all well. Had measles when a child. Well until seven months ago, when he began to have circulatory disturbances in his legs and feet.

On February 9, 1909, he noticed that his urine was red and that he was passing urine every two hours. Next day there was sudden severe pain on the right side, posteriorly, in the region of the kidney, extending anteriorly downward to the groin. He had chills and fever. His urine was red for a few days; then there was an increased amount of urine, which was normal in color for two days, when blood again appeared. Patient urinated every two hours, but there was no other symptom.

Examination of the patient demonstrated that he was suffering from nephritis. All of his arteries showed advanced arteriosclerotic changes.

On February 14, 1909, he had a severe attack of pain in the right lumbar region and the muscles protecting the kidney region were rigid. There was extreme tenderness, especially at a point one inch below the intercosto-vertebral angle. The urine was bloody, neutral, with a large amount of albumin in proportion to the amount of blood present. On February 19, 1909, his urine was amber-colored, acid in reaction, 1015; moderate amount of albumin, a few red blood-cells, and a few hyaline casts. On February 20, 1909, no casts were found. On February 15, 1909, red blood-cell count, 5,540,000; leukocytes, 16,000; polynuclears, 79 per cent.; hemoglobin, 120 per cent. The red blood-cells were very high in hemoglobin. His blood-pressure on February 14 was 132 mm. of mercury. February 19 it was 150 mm. of mercury. Wassermann reaction was doubtful.

First operation, February 20, 1909: Four-inch incision two inches above the crest of ilium, and evacuation of a *retroperitoneal hematoma* extending down into the pelvis from the kidney region. This was drained. The blood from this hematoma was sterile.

Second operation, March 8, 1909, by Dr. Delatour: On account of persistent hemorrhage from the right kidney, with no other symptom except a slight increase in the temperature and progressive hematuria. The right kidney was removed. Following this operation the patient made a temporarily good recovery.

On March 10, 1909, his urine was clear, acid, 1022; heavy trace of albumin, few pus-cells, no red blood-cells. Urine, April 11, 1909, cloudy, acid, 1016; trace of albumin, few red blood-cells, hyaline and granular casts. These casts were present until the end.

There developed symptoms of sepsis in other parts of the body, and on April 10, 1909, an ischio-rectal abscess was evacuated. The patient died a few weeks later of general septicemia. The examination of the kidney which was removed showed an advanced stage of arteriosclerosis with interstitial and parenchymatous nephritis.

2. RENAL VARIX

The writer first applied the name of renal varix to that condition of localized increased vascularization of a renal papilla so often found in cases of painless hematuria. Fenwick* reported three cases in which distinct vascular abnormalities were found in one of the papillæ of the kidney; two of these cases were cured by papillectomy and one by nephrectomy. In his first case the vessels of the mucous membrane covering the papillæ were markedly varicosed; in the second case a bright red varicose condition similar to the first case was found; in each, recovery followed removal of the affected papilla. In the third case, in which nephrectomy was done, a dark purple papilla appeared and a little blood was seen oozing from a point in the apex. He also reported three other cases, in two of which simple nephrotomy was done and the kidney found to be the seat of subacute nephritis. In the three latter cases no abnormal condition of the papillæ was definitely made out.

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* Fenwick, H.: "Clinical Cystoscopy," London, 1904, p. 392.

In March, 1908, Whitney and Cabot* reported a case in which the tips of one or two of the papillæ at one end of the kidney were reddened and a little spongy; the microscopic examination showed the small venules at the tips of the papillæ irregularly dilated and covered on their free surface with a fine film of connective tissue and a single layer of epithelial cells, projecting here and there as varicose knuckles; no well-marked thrombi were found. The straight tubules of this region contained blood-corpuscles, which were not found higher up, indicating this to be the source of the hemorrhage. MacGowan† reported a case of painless hemorrhage, of two weeks' standing, in a man aged forty-five years; nephrotomy was done, and one papilla that was dark purple in color and was bleeding continuously was removed by a wedge-shaped incision; the sides were then united by one stitch of fine catgut, the kidney was sutured, and an uneventful recovery followed. Later he reported three cases with telangiectasis of one of the papillæ.

* Whitney and Cabot: "Boston Med. and Surg. Jour.," vol. clviii, No. 21.

† MacGowan: "Ann. of Surg.," vol. li, No. 4, page 541.

Symptoms.—The history of all the cases is very much alike. The patient, usually in good health, suddenly notices the presence of blood in his urine. There is nothing to account for its presence; there has been no undue exercise, no injury, no infection, no history of renal colic; no pus-cells, epithelial elements, crystals, tubercle bacilli, or other abnormal ingredients are found in the urine, other than blood, which is at first small in amount, then either increasing or decreasing, and often at times absent altogether; in some cases the amount of blood is influenced by exercise, while in others this plays no part. In two cases of my own the quantity of blood seemed to be greater in the morning and to lessen as the day advanced. It occurs with varying frequency in both men and women over twenty-five years of age. Some patients have had alcoholic habits, while others have been total abstainers—in fact, there is no type or class of person in whom the disease has been more frequently observed. The hemorrhage may last but a few days, only to disappear and recur again after periods of weeks or months or even years; or, again, it may be continuous from the first, causing progressive anemia.

As a rule, the urine is loaded with blood and, at times, with free hemoglobin; the blood-cells are evenly distributed throughout the urine, appearing in all parts of it as it is evacuated from the bladder; clots may be found in the bladder, to be expelled at intervals; as the specimen stands, the cells rapidly fall to the bottom of the glass container; and it has been observed in my own cases that the urine retains its reddish color after precipitation of the cells, probably due to free hemoglobin.

The urine shows no evidence of renal disease other than a reaction for albumin in proportion to the amount of accompanying blood-serum, except where nephritis is present —a condition which of itself may give rise to hematuria, but which should not be classed with the cases under consideration.

Rarely, the patients complain of pain or distress in the affected kidney or over the bladder, but it has been observed in some cases that all the pain and discomfort have been referred to the opposite kidney. The disease is always unilateral, and no cases, so far as the writer can learn, have ever been reported where the disease affected both kidneys. It is true that symptomless hematuria is frequently bilateral, but those are the cases due to malaria, hemophilia, drug-poisoning, nephritis, or other cause quite different from those included in the present report.

Diagnosis.—The first consideration is the history which the patient presents, such as has been described above. One naturally thinks first of malignant disease, papilloma, hypernephroma, malaria, nephritis, hemophilia, or renal varix; more rarely of stones or tuberculosis.

It is necessary, in the first place, to exclude the urethra, the prostate, the bladder, and the ureter as sources of the bleeding; and there are but two ways in which this can be done with accuracy: (1) by surgical operation and (2) by the use of the cystoscope. Of the two methods, the cystoscope is the more accurate, although errors have been recorded in both cases. By the aid of the cystoscope and the ureteral catheter it may be determined that the bleeding is coming from one or the other kidney; this is the most important point of all, and it then only remains to determine what is the probable cause of the hemorrhage. There are some cases where, owing to the large amount of blood present at all times in the urine, it is almost impossible to make a satisfactory cystoscopic examination; if repeated washings of the bladder do not clear up the blood, the bleeding is more probably of bladder origin, but if this cannot be definitely made out, in the presence of the symptoms or renal varix, an exploratory operation upon the kidney is the indicated procedure.

Differential Diagnosis.—By the aid of the *x*-ray or the wax-tipped ureteral catheter the presence or absence of stone can be determined with considerable accuracy; aside from this, the symptoms of renal colic, together with a transitory and insignificant amount of blood in the urine, and the entire symptom-complex, as a rule, are sufficient to differentiate renal calculus from renal varix; but in some cases nephrotomy is necessary to the final establishment of a diagnosis.

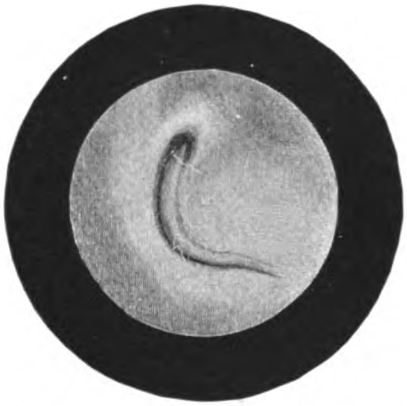

Fig. 236.—Cystoscopic picture showing blood-clot hanging from ureter opening (Nitze).

Chronic nephritis, with unilateral hematuria, is probably the most difficult disease to exclude, and this is not always possible even at operation. In a case reported by Freeman,* the only clinical difference, from a diagnostic standpoint, to be noted was that casts were found, and these were not definitely made out until after operation.

In *tuberculosis of the kidney,* in the writer's experience, the bleeding is so insignificant that it should seldom be confused with renal varix; in addition, pus will always be found, and at some period tubercle bacilli, with other systemic expressions of the disease.

Neoplasms of the kidney are not so easily differentiated; many times it is impossible until after the kidney has been laid open to say definitely that a new-growth is not present. However, except in the case of papilloma of the kidney, which is extremely rare, the bleeding is markedly less in amount. The hemorrhage generally occurs suddenly. There may be a single attack during sleep and then it will not occur again for weeks or months. At one time almost pure blood will be passed and at the next time the urine will be perfectly clear. The hemorrhage is more influenced by exercise, and the cachexia is more extensive in proportion to the loss of blood.

Illustrative Case.—The writer has had five distinct cases of renal varix under his care, in four of which the correctness of the diagnosis was substantiated at the time of operation. The history in detail of one case which is fairly typical is as follows:

CASE.—Patient referred by Dr. Harold Jewett. A man, fifty years of age. Had malaria and scarlet fever in child-hood; no venereal history. Four years previous to examination, without known cause, his urine became dark red or chocolate-colored. This discoloration of the urine lasted a month or two and then suddenly disappeared, and the urine became clear again.

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* Freeman, L.: "Ann. of Surg.," vol. xxxix, 1904, p. 370.

Status.—The patient had been drinking heavily. In October, 1908, he noticed the return of his former condition. There was no symptom other than a large amount of blood in the urine. This was more marked in the morning on rising and cleared up somewhat as the day progressed. There was some increased frequency of urination during the day. He was very nervous and had lost considerable in weight. Physical examination showed his heart to be normal, his liver enlarged, but otherwise negative.

Examination of the urine showed the specimen to be loaded with blood, the cells sinking rapidly to the bottom of the glass container and the supernatant fluid retaining its red color, showing the presence of free hemoglobin.

Iron and quinin were administered in various forms; in November, the fluidextract of ergot, in one half-dram doses every four hours, was administered. At this time the urine was still loaded with blood. Two days after he began taking the ergot the urine became perfectly clear and remained so for two days, then it was more bloody than before. This continued for a number of days, and then, without any medication, the urine became clear again and remained so for a few days and the blood reappeared. On December 10, 1908, it was clear and remained clear on the 10th, 11th, and 12th of December; then the blood reappeared and was present off and on up until April, 1909.

Cystoscopic examination showed blood coming from the left ureter.

The writer presented the history of the case before the Brooklyn Surgical Society and made a clinical diagnosis of renal varix.

On May 1, 1909, the patient consulted Dr. Hugh Young, of Baltimore, who also found hemorrhage coming from the left kidney. He injected the pelvis of this kidney with three drams of a 1 in 5000 adrenalin chlorid solution. After a day or two the hemorrhage stopped, and it did not return for about ten days.

The patient returned to Brooklyn in the same condition as before.

On January 11, 1910, a cystoscopic examination showed the left ureter opening normal in appearance and secreting blood-tinged urine at regular intervals. There were a moderate number of leukocytes, a few renal cells with a few epithelial and red blood-cells being excreted from the renal pelvis. Bacteriologic examination of the urine from the left kidney was negative. The renal pelvis was washed out with adrenalin chlorid solution in order to check the hemorrhage temporarily.

Operation, by the writer, at the end of a week. The left kidney was exposed and was found to be surrounded by a mass of fat and many fibrous bands which bound down the kidney. These were separated with much difficulty. In order to bring the kidney up out of the wound it was necessary to resect the twelfth rib. The kidney was somewhat congested and enlarged. It was bisected along Broedel's line and the pelvis and all of the calyces were opened. The papillæ at the upper pole of the kidney were congested and one of the lower papillæ showed on its surface a roughened, granulated mucosa making it appear somewhat whiter than the other papillæ. After the kidney had been thoroughly inspected, and the varicose and congested condition of the papillæ noted and demonstrated to a number of the surgeons who were present, the two halves of the kidney were brought together and sutured with two layers of mattress sutures, using plain catgut. The capsule of the kidney was sutured with a separate catgut suture, a drain was inserted into the lower and central portions of the wound, and the rest of the wound closed. The patient made an uneventful recovery, the blood disappearing from the urine within seven days after the operation. It is now a year and a half since the operation and the urine has remained perfectly clear.

We are dealing, then, with a distinct pathologic entity which may be described as a telangiectatic disease of the papillæ renales. Its etiology and pathology resembles that of varicocele, varicose veins of the legs, varicosity at the cardiac end of the stomach, hemorrhoidal varices, etc. It has its own distinct symptomatology, but it may be impossible to differentiate it before operation from hematuria due to nephritis and hematuria due to renal varix. In the majority of cases, at operation, when the kidney has been bisected, no gross pathologic lesion will be noted, but on microscopic examination of the papillæ renales a typical angioma will be found.

Indications for Treatment.—If the diagnosis has been fairly established and the hemorrhage is at all alarming, operation is indicated. In the early stages of the disease the hemorrhage may be controlled by washing the pelvis of the kidney with a 1 in 5000 solution of adrenalin chlorid. Later this will not affect the bleeding. Renal decapsulation and fixation of the kidney will cure a case of unilateral hematuria due to nephritis. In renal varix nephrotomy is the operation of choice, because it allows a thorough examination of the kidney. Also, for the reason that it accomplishes exactly what the operation of multiple ligation does in the treatment of varicosities in other portions of the body, in that it cuts six of the connecting venous radicles of the kidney and in this way destroys the varicosities. Nephrectomy is indicated only when rapid and bloodless operation is demanded, or when nephrotomy fails to relieve the hematuria; resection of a renal papilla may be done if the disease is confined to one papilla.

Hugh Cabot believes that decapsulation and fixation is as valuable as nephrotomy in these cases. He also states that preliminary blood transfusion has met with success in two cases.

3. VILLOUS PAPILLOMA OF THE PELVIS OF THE KIDNEY

This is a rare condition of the kidney. It may occur as a single papilloma or as a diffuse villous growth scattered over the mucous membrane of the pelvis. Its position may be such as to obstruct the ureter from time to time, giving rise to hydronephrosis. It may be secondary to a calculus. Although the microscopic sections of the growth do not associate it with a malignant disease, still, clinically, it is malignant in that it tends to recur and frequently degenerates into a carcinomatous growth.

Symptoms.—In the early stages of its growth, hematuria is the only sign of its presence. The urine is otherwise normal. Hemorrhage takes place suddenly, without warning, independent of motion, and ceases suddenly, leaving the urine perfectly clear. Fragments of the growth may be washed away with the urine or appear at the ureter opening in the bladder. Secondary growths of the bladder are sometimes seen. There is no absolute way of diagnosing this condition except by exclusion. A villous papilloma may be suspected, but its presence can never be proved without operation.

HEMATURIA ASSOCIATED WITH OTHER SYMPTOMS

The occurrence of hematuria in renal varix, renal calculus, renal tuberculosis, etc., has already been described. The associated lesion which gives rise to the hemorrhage is usually demonstrated by the combined physical and cystoscopic examination and the urinary findings. The following diseases or lesions of the kidney are diagnosticated by direct evidence.

1. TRAUMATIC INJURY OF THE KIDNEY

Injuries of the kidney are most frequently the result of a direct force, either a blow, a fall, or a crushing accident. Numerous cases, however, have been seen which were the result of muscular force alone. The diagnosis of this condition is, as a rule, made by direct examination in connection with the history of the case, and need not be dwelt upon here. The sudden appearance of blood in the urine following an injury affecting the body in the renal zone is direct evidence of some injury to the kidney or ureter. If the diagnosis is questioned, a cystoscopic examination may be made to determine whether the blood is coming from the bladder or either kidney, but ureter catheterism is, in all cases, contraindicated. If the ureter is entirely torn across, hematuria does not occur.

Indications for Treatment.—An expectant treatment is indicated in a case of slight injury to the kidney in which there is only moderate or transitory hemorrhage of short duration. Operation is contraindicated where both kidneys are extensively injured. Operation is strongly advised where there is progressive, recurring, or persistent hemorrhage; also, when infection has taken place.

2. ANEURISM OF THE RENAL VESSELS

This is a rare lesion, but, nevertheless, one which must be considered. There is usually a history of some injury involving the kidney. The onset of symptoms is variable. The first symptom may be pain, hematuria, or the gradual formation of an abdominal tumor in the renal zone. Pain in the affected kidney may be entirely absent, but usually is a marked and persistent symptom which depends naturally upon the situation and extent of the disease. The characteristic symptoms of aneurism, other than the presence of a rounded, fixed, slightly tender tumor, are not found. Hematuria is usually a marked symptom.

Diagnosis.—The chief points of diagnostic value are the history of an injury and the gradual formation of an abdominal tumor, associated with more or less marked hematuria; the bleeding is more constant than is usually found in malignant disease. In the majority of cases operation alone will establish the diagnosis.

3. FILARIA SANGUINIS HOMINIS INFECTION

Hematuria may be present alone or be associated with chyluria. In this climate the occurrence of such an infection of the kidney is rare. The finding of the filaria sanguinis hominis in the urine or blood is the only positive sign of diagnostic value. In one case examined by the writer the disease affected only the left kidney.

4. BILHARZ'S DISEASE

When the kidney becomes infected with distoma hematobia bilharzii, the disease is characterized by a persistent hematuria, irritability of the bladder, frequent urination, the frequent association of renal and vesical calculi, and the finding of the ova of the parasite in the urine and feces. In Egypt it is one of the most frequent causes of hematuria, and must always be excluded before other lesions of the kidney are diagnosticated. In advanced stages of the disease there are anemia and a general septic state. The urine shows a moderate number of pus-cells. Cystoscopic examination will usually disclose congested and raised-up patches of tissue within the bladder, varying in size and covered with a grayish mucus. After the ova escape from these nests, a hemorrhagic spot is left. There are also other parasitic diseases which occasionally occur, but are too rare to demand consideration.

CHAPTER IX

UNCLASSIFIED DISEASES OF THE KIDNEY

CYSTIC DISEASE OF THE KIDNEY

SINGLE and multiple cysts are frequently associated with other diseases, being simple retention cysts. Such cysts are met with in tuberculosis of the kidney, neoplastic disease, and chronic interstitial nephritis. There are no symptoms in these cases to make a diagnosis possible.

SOLITARY CYSTS OF THE KIDNEY

Solitary cysts of the kidney are occasionally seen. Their pathology is uncertain, but they are probably retention cysts. They are found in the cortex of the kidney and may occupy any portion of it. The larger cysts have been found at the lower pole of the kidney. Unless they reach considerable size they are of no importance.

Diagnosis.—The only symptoms present depend upon the size and position of the cysts. If small, a diagnosis is not possible. If large, the symptoms are those due to pressure. It is possible to differentiate between a large solitary cyst of the kidney and a hydronephrosis only by using a ureter catheter and measuring the pelvis of the kidney, or by aspiration of the cyst and examination of its contents.

POLYCYSTIC DEGENERATION OF THE KIDNEY

The pathologists have not decided definitely whether this condition is entirely of congenital origin or partly due to processes which develop after birth. The important point is that both kidneys are usually involved; the two may be in different stages of degeneration. A few cases of unilateral involvement have been reported.

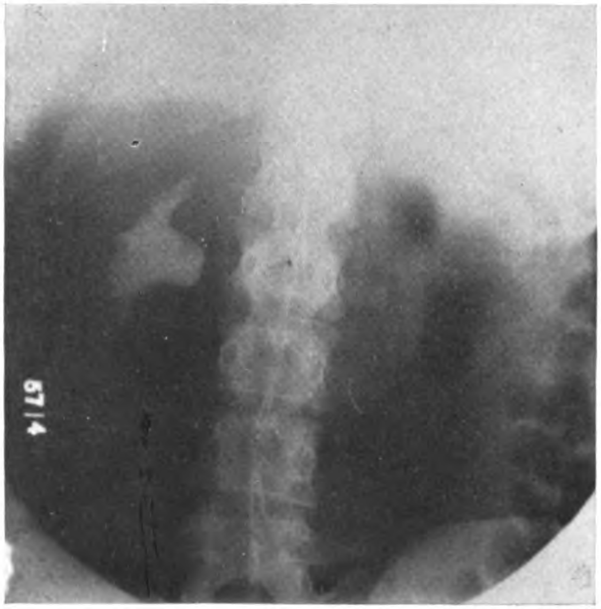

Fig. 237.—Radiograph of normal renal pelvis containing 18 c.c. of fluid. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

Symptoms.—The condition is extremely difficult to recognize, and the diagnosis is possible only by exclusion. The symptoms are those due to the presence of a tumor, the changes in the urine due to an interstitial nephritis, the various nervous reflex phenomena arising from an enlarged, heavy, prolapsed kidney, and later, hematuria and renal insufficiency, with the development of uremia.

On palpation the kidney can usually be felt, and will be found to be enlarged, its surface somewhat irregular and retaining its original shape. The second kidney may not have reached the same stage of development as the first.

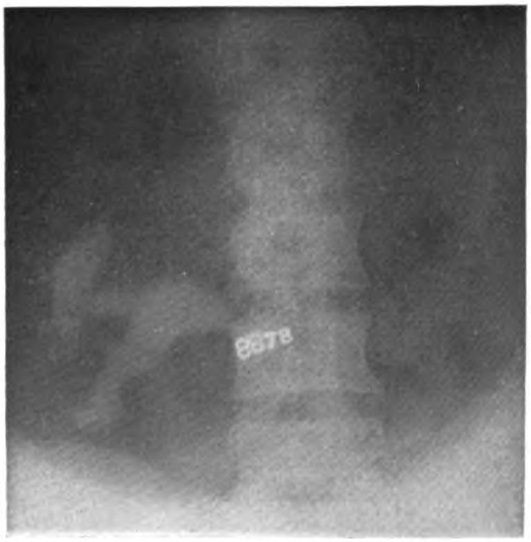

Fig. 238.—Radiograph showing renal pelvis in a case of polycystic kidney. It will be noted that the pelvis is irregularly retracted. Compare with Figure 237. (Case from the collection of Dr. W. F. Braasch, Rochester, Minn.)

The enlargement is not tender, and is not, as a rule, associated with inflammatory phenomena.

These kidneys sometimes become infected. They then present the usual symptoms of pyonephrosis.

Ureteral catheterism and examination of the separate urines may give evidence of unilateral involvement as found in one case examined by the writer.

Diagnosis.—It is only rarely that one can make an absolute diagnosis. If a patient is presented suffering from anemia, cardio-vascular changes, gastric disturbance, pain, and discomfort in the renal zone, whose urine contains albumin and other evidences of nephritis, and who presents soft tumors in each renal zone which retain the shape of the kidney, and there are no evidences of suppuration, one would be justified in making a diagnosis of polycystic degeneration of the kidneys.

ECHINOCOCCUS CYST OF THE KIDNEY

Echinococcus cyst of the kidney is a rare condition. When present, it is of slow development, without noteworthy symptoms. Finding the characteristic hooklets in the urine, taken together with a history of a slowly developing tumor in the renal zone, would definitely establish the diagnosis. Unfortunately, it is rarely that the hooklets appear in the urine, because the cyst does not communicate with the pelvis of the kidney.

The same subjective and objective symptoms are found as in solitary cysts of the kidney.

SYPHILIS OF THE KIDNEY

Syphilis of the kidney occurs in two forms: First, as a syphilitic, diffuse nephritis, and second, as gummatous tumors of the kidney.

The diagnosis can only be made from the history of the case, substantiated by a positive Wassermann or Noguchi blood reaction. A lesion of the kidney in the presence of syphilis would suggest the spirocheta pallida as its cause.

PART VII

THERAPEUTIC USES OF THE CYSTOSCOPE

SECTION I

GENERAL THERAPEUTIC USES OF THE CYSTOSCOPE

In discussing the various forms of disease met with in the bladder, ureter, and kidney, we have indicated the method of treatment applicable with the aid of the cystoscope in each case. It is now proposed to take up systematically the different forms of treatment made possible by the introduction of the illuminated endoscopic tubes and the operating cystoscope.

DIRECT TREATMENT AND TOPICAL APPLICATIONS TO THE BLADDER

For this purpose the Kelly endoscopic tubes may be used in the female and the Braasch hollow-tube cystoscope or the Lewis operating cystoscope in the male. All that is essential is that a hollow tube be introduced through the urethra into the bladder, that the bladder be dilated with air and properly illuminated.

For Topical Applications.—Through the cystoscope almost every portion of the bladder may be exposed, so that we are able to treat any localized area of disease without destroying normal mucous membrane.

Localized or patchy cystitis usually may be cleared up very quickly by local applications of 1 per cent. to 2 per cent. solutions of silver nitrate, followed later by simple irrigation of the bladder with warm boric acid solution.

Simple ulcers of the bladder usually are partially incrusted with phosphatic salts, which should be removed with a curet before the stronger solutions of silver nitrate are applied.

For Removing Foreign Material from the Walls of the Bladder.—In the chronic inflammatory diseases of the bladder, with ulcer formation, and also with large rough calculi in the bladder, the wall of the bladder is often partially covered with necrotic sloughing bits of tissue on which are deposited phosphatic salts and crusts. These are best removed by using a curet and forceps through a cystoscopic tube. Then direct applications may be made.

For Removing Foreign Bodies from the Bladder.—The possibility of doing this depends greatly upon the size of the object encountered. The deposition of salts on a foreign body in the bladder causes a gradual increase in its size. Viewing it through the cystoscope, its size may be judged and the feasibility of its removal *per viam naturalem* be determined. If its increase in size is due to calculous formation, it may be possible to crush it with a lithotrite and then remove it.

The object may be larger than the lumen of the cystoscope. If so, the object may be grasped with forceps introduced through the cystoscope and the cystoscopic tube be withdrawn, the forceps still in place, its grasping end protruding from the distal end of the cystoscopic tube, and as the tube and forceps are withdrawn, the foreign body is dragged out through the urethra.

For the Treatment of Diverticulitis.—Diverticulitis, or localized inflammation of a diverticulum, is not an uncommon disease. The long continuance of the inflammation is due partly to the fact that the diverticulum does not empty itself with the ordinary contractions of the bladder, and therefore is subjected to the traumatism of residual urine, and also because irrigations and ordinary lavage of the bladder do not reach the inflamed interior of the sac. The cystoscope helps us to overcome this:

1. Using the catheterizing instrument, a catheter is passed into the diverticulum and the urine is drained out. Then a strong solution of silver nitrate is injected directly into the sac.

2. Through an endoscopic tube curets and other instruments may be introduced and the sac emptied of any irritating material which it may contain; then direct applications may be made.

Illumination of the Bladder and Drainage During Suprapubic Section.—A simple and effective method of illuminating the bladder during operations by the suprapubic route is by means of the sheath and lamp of the Buerger cystoscope. The instrument is introduced through the urethra and the obturator is withdrawn; the beak points toward the anterior wall, and the light is turned on. In this way we have a perfect illumination of the bladder, combined with a drainage-tube which carries off all the blood and urine during the operation, keeping the field of operation dry.

Placing of Catheter in the Ureter as a Guide to Operating.—This should always be done in cases of extensive carcinoma involving the pelvic viscera. It would prevent many accidents in pelvic surgery if done as a routine.

IN TREATMENT OF DISEASES OF THE KIDNEY

Lavage of the Renal Pelvis.—Lavage of the renal pelvis has already been described and illustrated on pages 331 and 336. It is indicated in all subacute and chronic catarrhal affections of the renal pelvis, but is of little value when infection has extended to the parenchyma of the kidney. In the treatment of non-suppurative nephritis I have found it of no curative value other than to relieve acute congestion and hemorrhage.

Technic.—A ureter catheter is passed to the pelvis of the kidney. Any fluid which is present in the pelvis is allowed to drain off. When this has been accomplished, the solution to be used in washing is slowly injected by means of a hand syringe. Experience has shown that it is unsafe to inject more than 5 c.c. of fluid into the renal pelvis in some cases. Inasmuch as we are not yet able to tell beforehand which cases fall in this class, we treat all cases with suspicion and limit our injections to 5 c.c. at a time.

Solutions to be Used.—Sterile water is as efficient as anything for the lavage. It should always be used if followed by a silver salt. Silver nitrate may be used in 1 per cent. or 2 per cent. solution; argyrol, in 25 per cent. solution; collargol, in 4 per cent. solution. Practically the same rules apply here as in lavage of the bladder.

Frequency of treatment depends entirely on the case.

The writer has employed renal lavage every four hours during the first day in a case of pyelitis of pregnancy, with good results. Some cases need only a single washing. If there is an abundant secretion of pus, lavage may be employed daily. In general, the same rules apply here as in washing the bladder. In its use in a large number of cases the writer has never had cause to regret the employment of renal lavage.

Drainage of the Renal Pelvis.—This is indicated in cases of acute hydronephrosis and pyonephrosis; also in the pyelitis of pregnancy with dilatation of the renal pelvis. A catheter may be safely left in place for four or five hours. Some operators have left the catheter in place longer without harm.

Injection of Hemostatic Fluids.—In some forms of renal hematuria a solution of adrenalin, 1 : 5000, may be safely injected into the renal pelvis. A few cases of renal varix have been temporarily relieved in this way. It cannot be considered as a curative measure.

SECTION II

SPECIAL THERAPEUTIC USES OF THE CYSTOSCOPE

CHAPTER I

VARIOUS SURGICAL PROCEDURES CARRIED ON BY THE USE OF SPECIAL INSTRUMENTS

MANY intravesical operative procedures, such as removing pieces of tissue from the walls of the bladder, including ulcers and new growths, enlarging the ureter openings, dilating strictures of the ureter, removing calculi from the ureter, and many other minor surgical operations, may be carried on through either type of operating cystoscope, including the endoscopic tubes of Kelly or the cystoscopes of Braasch, Lewis, or Tilden Brown. There are, however, certain newer instruments which offer individual features. These will be taken up systematically. Before recommending the use of any of the operative cystoscopes we wish to emphasize that we do not think it safe to take samples from the bladder for microscopic examination, especially in the presence of suspected malignancy.

The Buerger Operating Cystoscope.—The instrument resembles very closely the Buerger catheterizing cystoscope. The sheath is more oval, and its telescope is provided with but a single outlet for the introduction of instruments of large caliber. Although two sheaths, the convex with a lamp on the convex side of the beak and the concave (Nitze type) are constructed, the concave type is the more useful and has a larger scope of application. In order to add to the strength of the deflecting mechanism and to keep the operating instruments properly directed against the lesions to be attacked, the telescope has been fitted with a fixation screw. Two optical systems, the right-angled and one which looks slightly forward, were adopted to suit the varying physical demands of operating, either near to the sphincter of the bladder or farther in the interior. It was found that by a special method of introduction instruments of considerable size could be made to enter the sheath of the cystoscope.

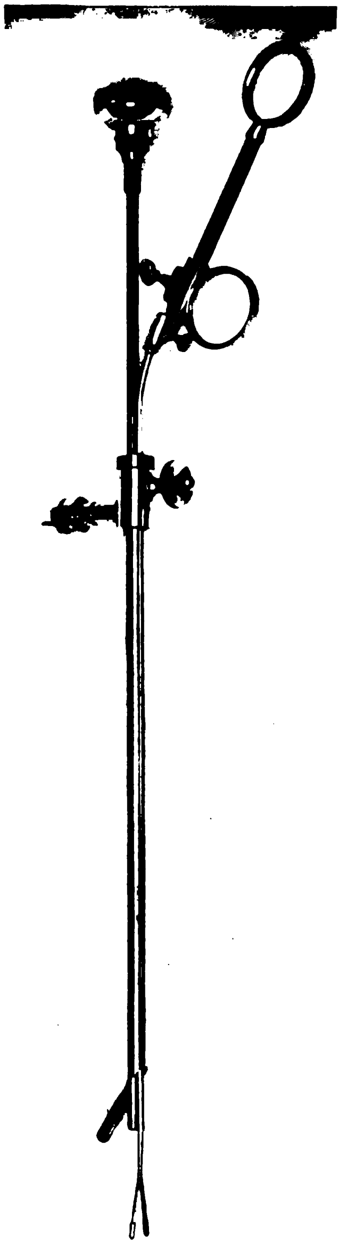

Fig. 239.—The Brown operating cystoscope.

The general assembly of all the instruments is the same, there being a wire shank carrying the working end or jaws (Fig. 240), a spiral flexible cannula, and a handle (Fig. 241). In the case of a large jawed forceps, it is impossible to introduce the working end through the catheter outlet, and we must execute the following manipulations for introduction. The cannula, provided with a sterile rubber cap to prevent leakage, is introduced through the catheter outlet. The working end and shank are now passed through the cannula as it lies in the telescope, the handle is attached, and the jaws are closed and locked. The telescope carrying the forceps, whose working end projects somewhat beyond the lens prism, is now inserted into the sheath, the jaws of the instrument entering in advance.

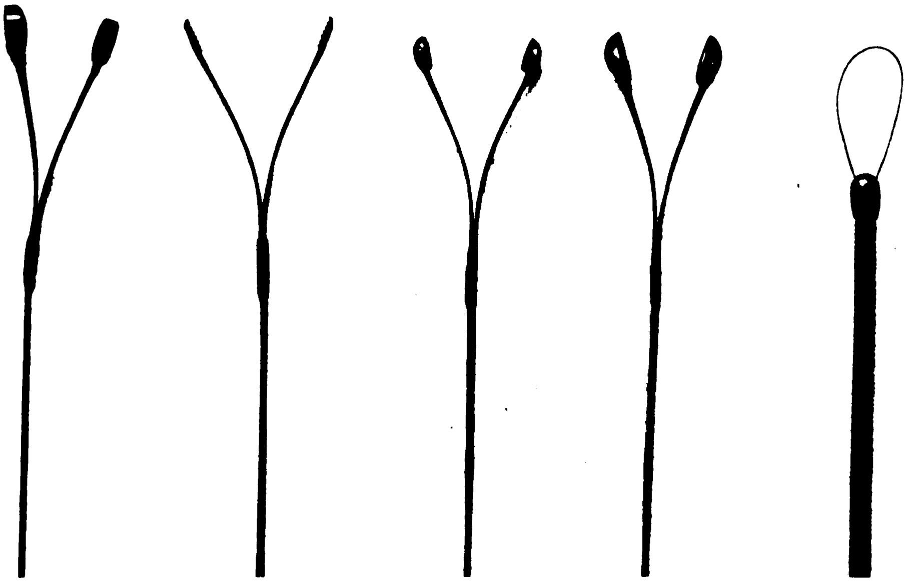

Fig. 240.—Working-ends of operating instruments; four forceps and a snare.

In seizing a foreign body or in ablating tissue, the closed forceps is deflected against the lesion (Fig. 242), the jaws are then opened and gradually closed as the beak of the cystoscope is made to approach the bladder wall. In this maneuver the whole instrument, as well as the shaft of the forceps, moves inward toward the lesion. This manipulation is necessary to compensate for the recession of the jaws as they are being closed. A new type of mechanism more recently constructed obviates the necessity of this somewhat disturbing "recession" of the jaws as they are being closed, and furthermore permits of work being carried out at close range (Fig. 245).

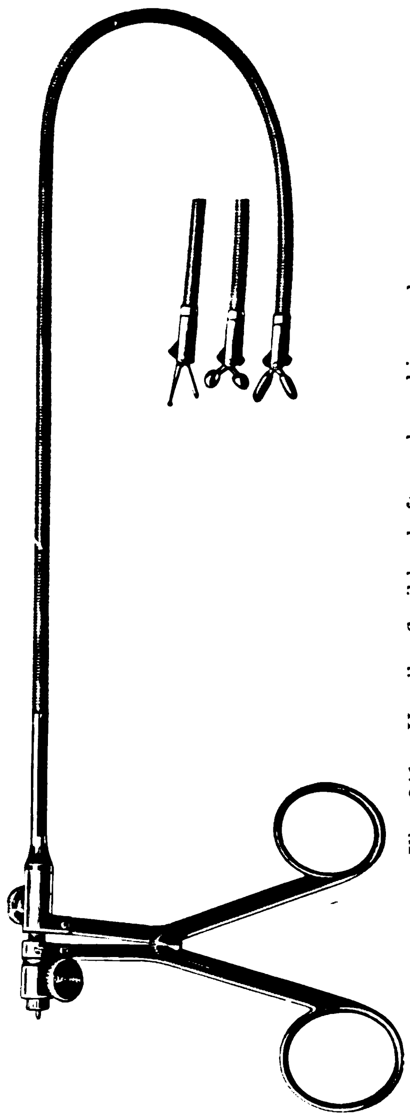

Fig. 241.—Handle, flexible shaft, and working ends.

Sample Excision of Tissue from the Bladder.—We cannot agree with some operators that it is indicated in tumors of the bladder to remove a sample for microscopic examination. We feel it is dangerous and unnecessary. In suspected tuberculosis of the bladder this sample excision is also questionable.

The Removal of Vesical Calculi.—Small vesical and ureteral calculi, if they are not too hard, may be crushed by a special miniature lithotrite (Fig. 247). When they are friable, they can be fragmented with the punch forceps, and the pieces can be easily removed with the cup-shaped jaws of the forceps. In the employment of this method of extracting small calculi the bladder is not subjected to the deleterious effects of aspiration by the usual suction-type of apparatus. By means of the small miniature lithotrite (Fig. 247) and the punch forceps the removal of descended ureteral stone lying in the bladder becomes extremely easy. In the cases of larger or harder stones that

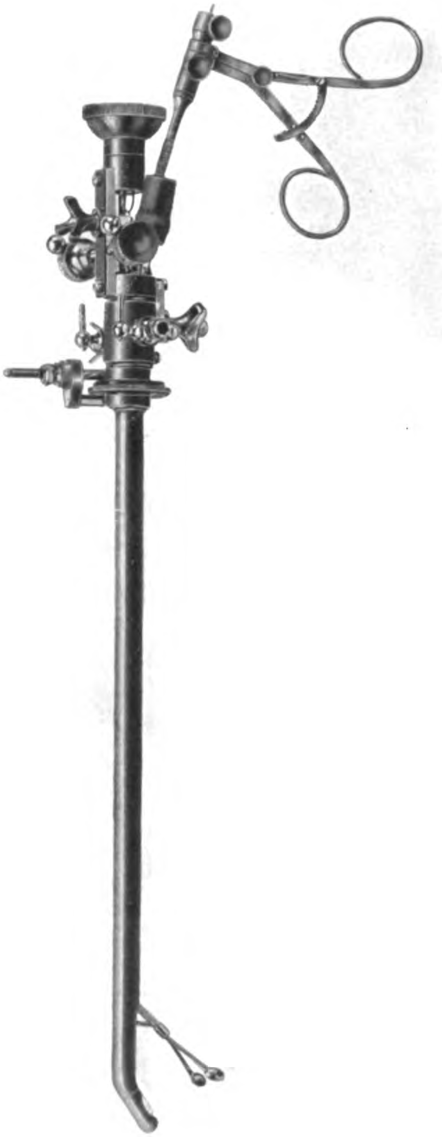

Fig. 242.—Complete assembly, with punch forceps ready in place.

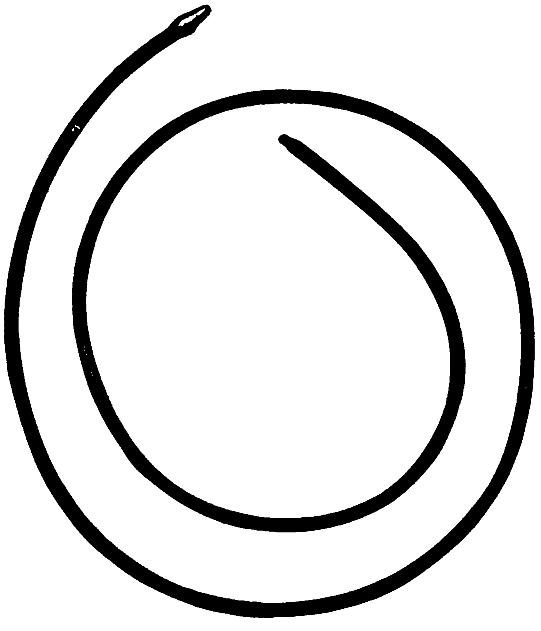

Fig. 243.

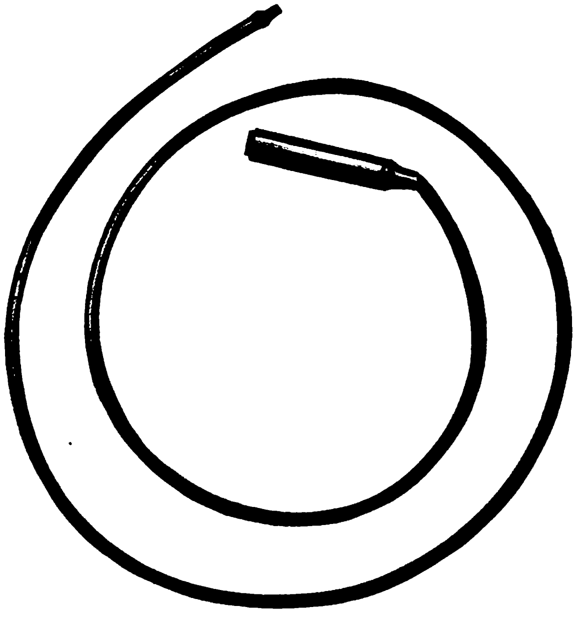

Fig. 244.

Figs. 243 and 244.—Insulated wire electrodes for use with metal olives.

cannot be crushed, the endovesical snare often serves as a reliable extractor.

Dilating the Ureters.—Ureteral calculi often become arrested in the lower portion of the ureter, due either to stricture, inflammatory exudate, or spasm, as a rule. Dilatation of this portion of the ureter may be accomplished by the insertion of graduated bougies, two or more small ureter catheters, and by the use of olive-tipped bougies used in connection with the d'Arsonval current. The technic of using the olivary tips with the d'Arsonval current is as follows:

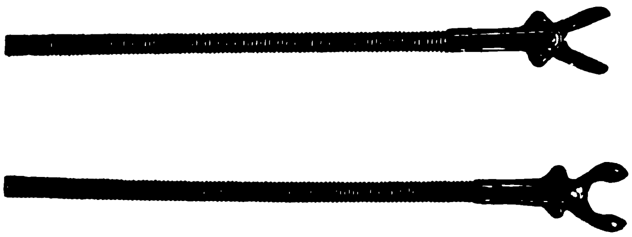

Fig. 245.—New type of cutting and punch forceps in which "recession" is obviated.

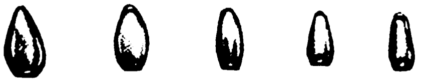

Fig. 246.—Metal olivary tips for use with high frequency current.

Detachable metal olives are screwed on the end of an insulated wire electrode. These can be introduced into the lower end of the ureter, after the fashion of a ureteral catheter. With a large indifferent electrode over the symphysis or lower abdomen, the second pole being the metal olive, a current of 200 to 400 milliamperes is allowed to pass while gentle pressure is exerted against the point of ureteral obstruction. In many cases we will be surprised to see the obstruction give way after a few seconds' contact. The olive is then removed and a larger one inserted, the process being repeated until the ureter is dilated to 12 to 18 Fr. or more. This method has been found valuable in many cases where forcible dilatation with bougies has failed. In a number of cases of descending ureteral calculi, where this procedure was carried out, a small stone lodged in the lower part of the ureter was passed shortly after dilatation had been performed (Buerger).

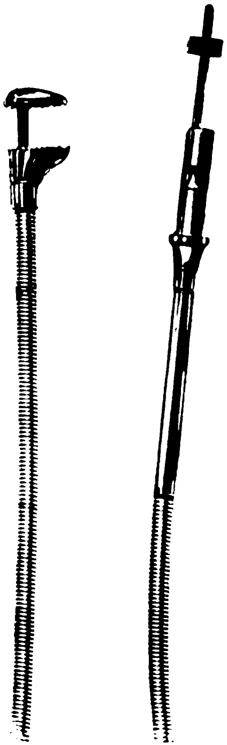

Fig. 247.—Miniature lithotrite: on the left, working end; on the right, proximal end for adjustment of handle.

Excision of Ulcers.—The inventor of this instrument reports two cases of simple callous ulcer of the bladder which were cured by removing the ulcer base with the punch forceps.

Incision of Cysts.—This is made possible by the use of a knife-blade mounted on a flexible cable, which can be introduced through the instrument.

Enlarging the Ureter Opening.—In case of stricture of the ureter opening or stone impacted in the lower end of the ureter the opening may be enlarged by cutting it with the knife-blade or scissor-forceps.

The Lewis Operating Cystoscope.—This instrument is used with either water or air as a distending medium for the bladder, with or without the lens telescope. It is especially useful in attacking stones in the lower end of the ureter. In such cases the instrument may be employed as follows:

The orifice of the ureter may be entered and stretched with the dilator, or incised with the scissors. The alligator forceps may be made to grasp a small stone engaged in the orifice, dislodging it, either by stretching the orifice or by traction on the stone. If the latter is situated higher up in the channel, say within an inch or an inch and a half of the orifice, it is possible to reach it by means of the flexible ureter forceps, modeled after the bullet forceps of old. This is introduced into the ureter closed; is advanced thus along the channel, the curves of which it can trace for the distance mentioned (I have used it as high as two inches in the ureter); when it meets with obstruction it is opened, gently advanced and closed again, and gradually withdrawn

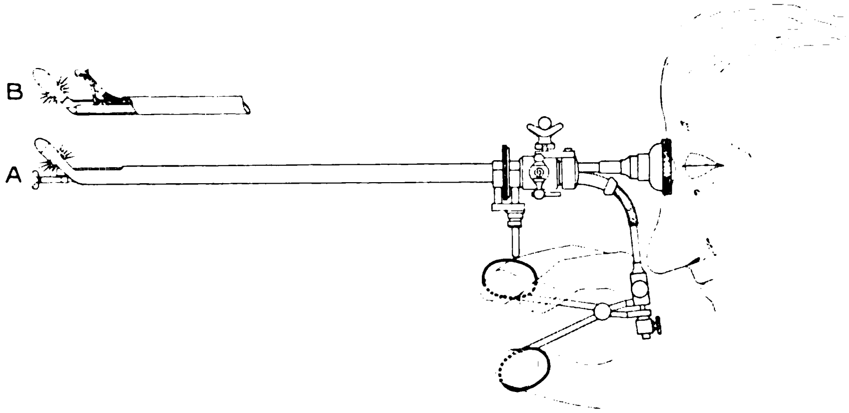

Fig. 248.—The Bransford Lewis combined universal and operating cystoscope, latest model, 1914. A, Forceps in use by direct method; B, same, by indirect method.

—with the hope of bringing with it the recalcitrant object. If not thus accomplished, all is not yet lost (Lewis).

If a ureteral stricture is interfering with the descent or expulsion of the stone, it may be dilated, either with the metal dilator already mentioned or by means of bougies of increasing sizes, introduced successively into the ureter past the offending part. Afterward, oil or glycerin may be injected through a ureteral catheter, paving the way to easier passage downward for the stone. Cunningham has

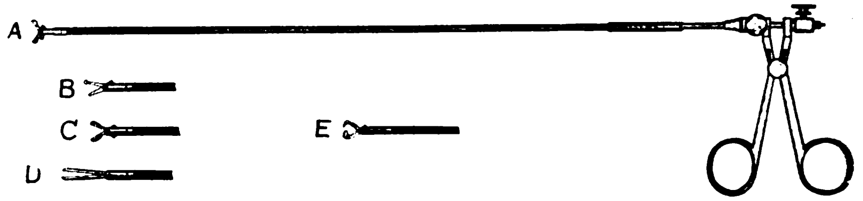

Fig. 249.—Appurtenances to Bransford Lewis universal and operating cystoscope, model, 1914. A, Flexible biting forceps; B, scissors; C, stone forceps; D, ureteral dilator; E, volsellum forceps.

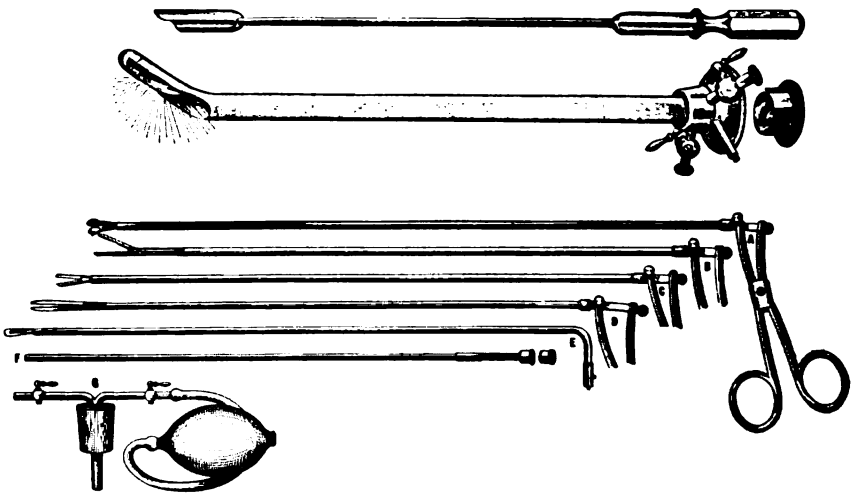

Fig. 250.—The Lewis operating cystoscope.

added an ingenious instrument, in the shape of a flexible sound of metal, with a tip that can be extended after it is brought into contact with the stone, in the hope of making the traction necessary for removal or descent of the stone.

It is not advisable to push the measures to an extreme in the endeavor to finish at one séance. It is preferable to be satisfied with slower progress, entailing less pain or anxiety on the part of the patient. In the interim, until the next essay at removal, he may be instructed to drink plentifully of water and other fluids, and to use a vessel and filter with each urination, in order to catch any stone that may possibly escape.

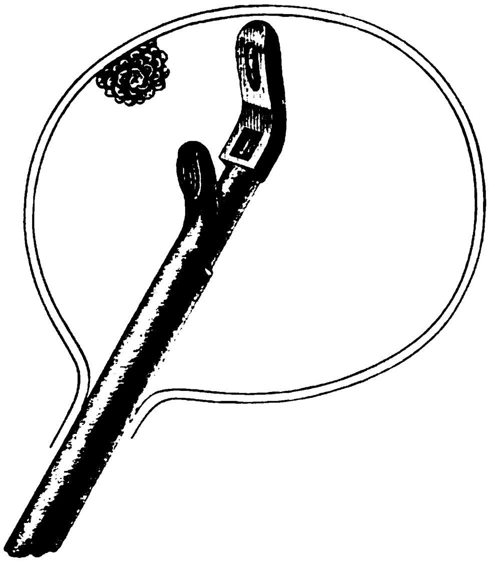

Fig. 251.—The operating cystoscope of Nitze with cautery attachment.

All the manipulations are carried out under efficient local anesthesia and should not be more objectionable than an ordinary cystoscopy or ureteral catheterization.

In addition, an expert may carry out many other operative procedures through this instrument.

The Nitze Operating Cystoscope.—This consists of many ingenious devices combined with his indirect catheterizing cystoscope. The most practical feature of the instrument is a catheterizing attachment. Of the two methods of application of the actual cautery in the bladder, one through an open endoscopic tube and the other by means of a specially constructed cystoscope of the closed type, with an electric cautery on its beak, the former is much to be preferred. Despite the ingeniousness of the instrument, the

Fig. 252.—The Nitze galvano-cautery cystoscope.

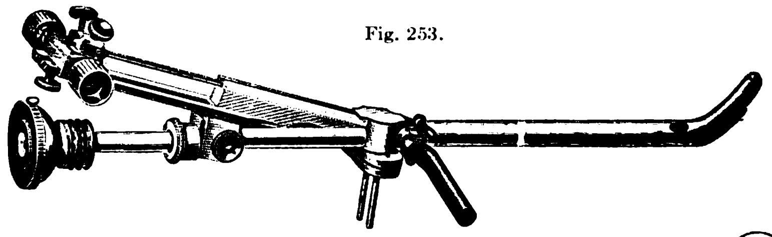

Fig. 253.

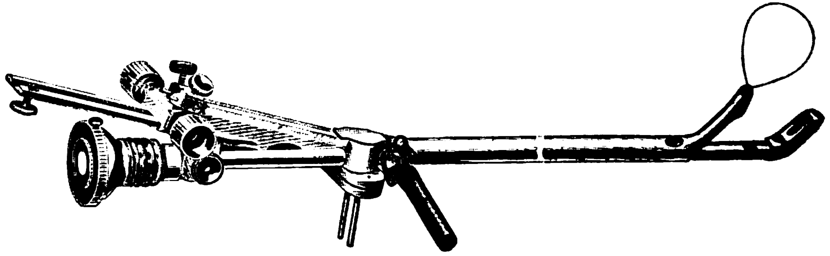

Fig. 254.

Figs. 253 and 254.—The Nitze hot loop cystoscope.

operating cystoscope of Nitze with its cautery is a dangerous instrument and should be used with great caution.

When using the cautery through an endoscopic tube, the patient is placed in a knee-chest posture, and the bladder dilated with air. The endoscope having been introduced, the area to be treated is carefully swabbed and dried and the cautery is applied. After the treatment, a small amount of warm saline should be allowed to remain in the bladder. The cautery attachment of the Nitze operating cystoscope may be used with either air or water as the dilating medium. This instrument combines a snare attachment with the cautery, so that a growth may be snared off and the base cauterized. The only danger is that the operation will be incomplete. Personally, the writer believes the open operation by suprapubic section is the one of choice in all cases of new-growth.

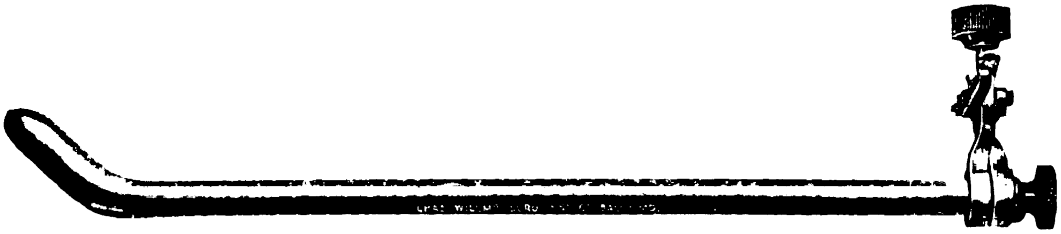

Fig. 255.—The Young rongeur cystoscope closed ready for introduction into the bladder.

Nitze devised two attachments for accomplishing this—one by means of a snare, and the other by means of a cutting forceps. The snare is more difficult to handle than the forceps.

The Young Rongeur Cystoscope.—This instrument, shown in Figs. 255 and 256, is superior to the snare of Nitze.

To handle this instrument successfully needs considerable experience, but its use in the bladder, to my mind, is not to be recommended. It was invented before the use of the high frequency spark to be described later.

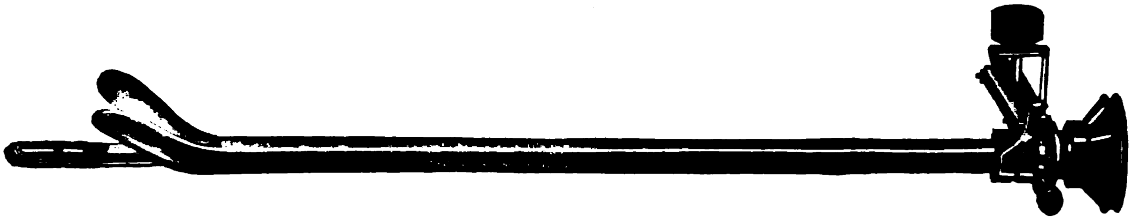

Fig. 256.—The Young rongeur cystoscope with the telescope in place and the jaws of the rongeur open ready for use in the bladder. When the new-growth is located it is brought within the jaws of the rongeur, the instrument is closed by bringing the jaws together, and the new-growth is cut off.

Lithotrites Combined with a Cystoscope.—A number of successful instruments of this type have been invented. The Albarran lithotrite was too small for practical use.

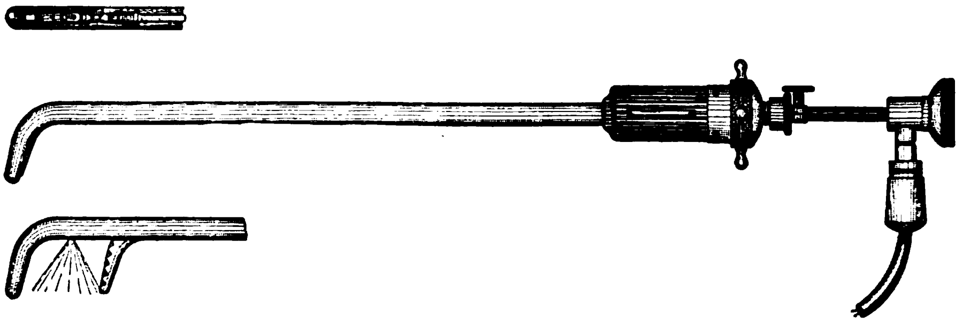

Fig. 257.—Walker's combined lithotrite with cystoscope.

The Nitze, Bierhoff, and Casper instruments have the disadvantage that one blade of the lithotrite is interposed between the prism and object to be seen, and is not strong enough.

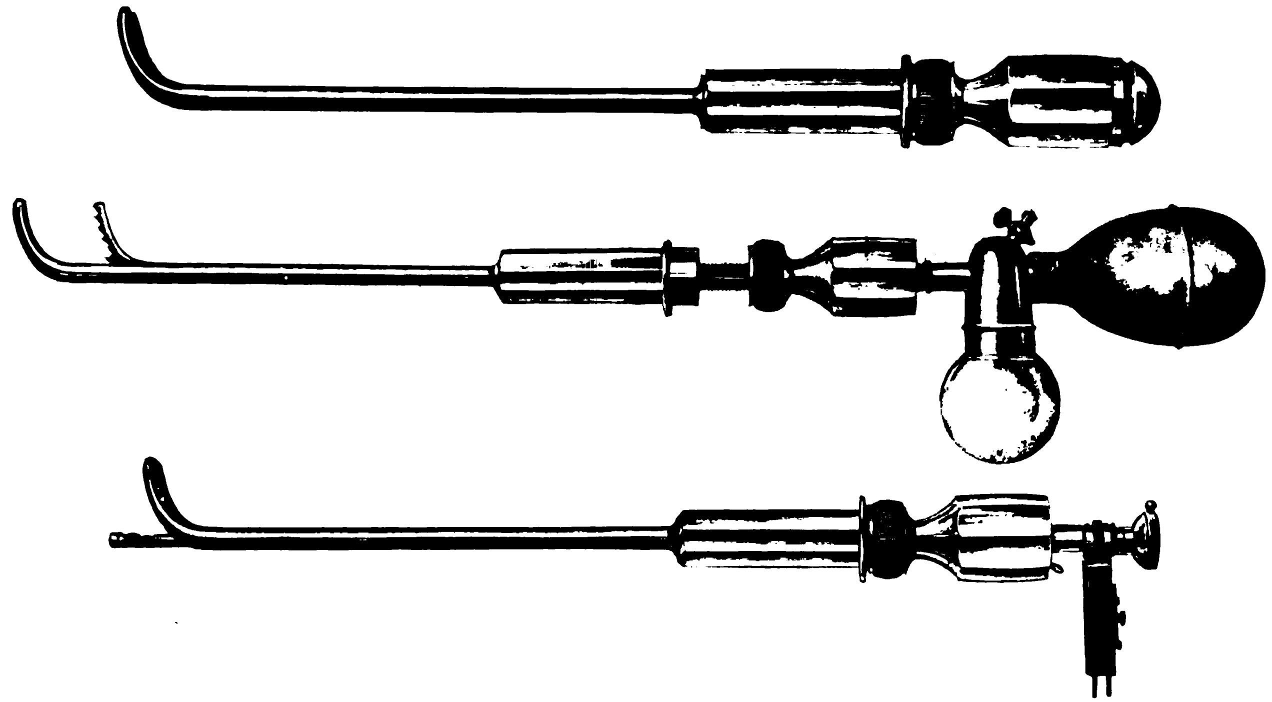

Fig. 258.—Young's evacuating cystoscopic lithotrite. The upper figure shows the instrument ready for evacuation. It is used as an ordinary Bigelow lithotrite. The middle figure shows the instrument used as an evacuator. The lower figure shows the instrument with a cystoscope inserted to see if any fragments remain. If any are found, the jaws are separated and with the cystoscope looking out between them the fragment is grasped and crushed. The cystoscope is then withdrawn, the evacuator attached, and the fragments evacuated. (See Transactions American Association of Genito-urinary Surgeons, 1910.)

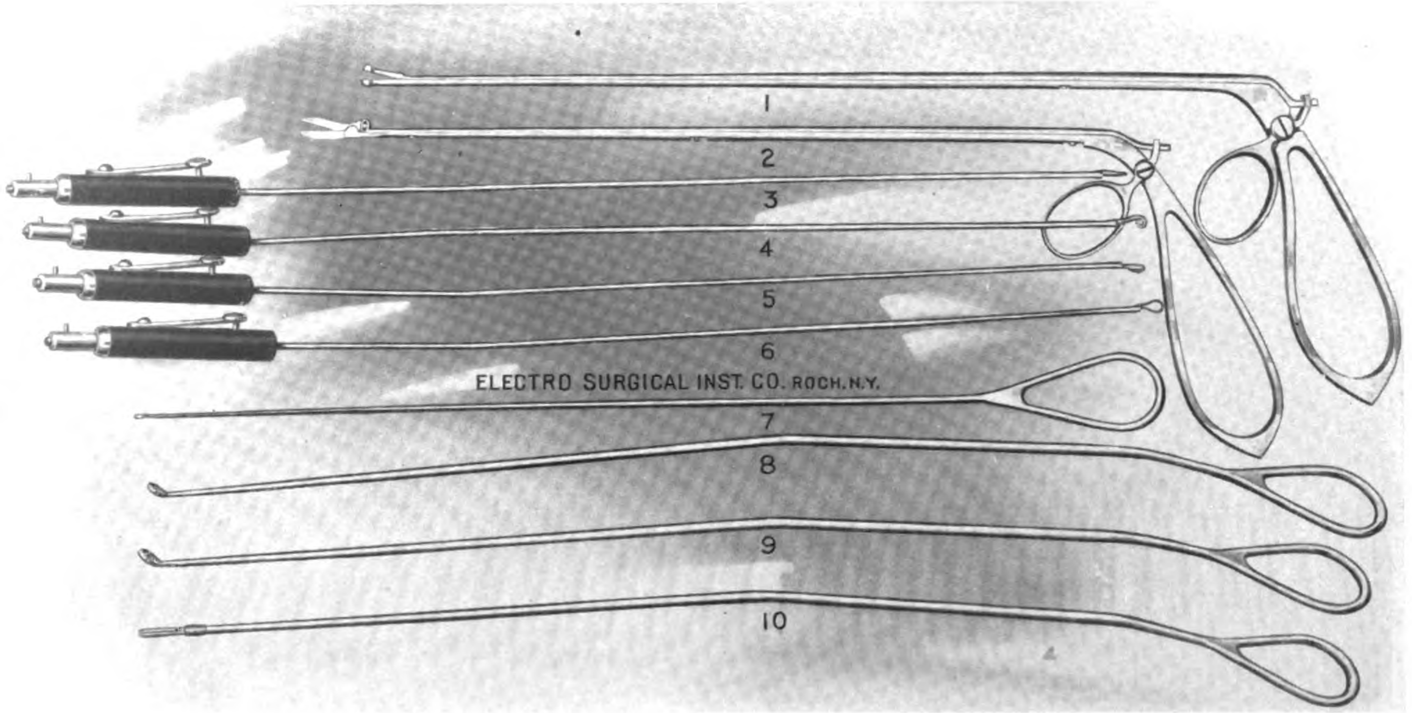

Fig. 259.—Young's instruments for use through an endoscope.

The Walker instrument is much more practical, being so arranged that one looks directly between the jaws. It is strong enough to stand a strain of 175 pounds. A detailed description of this instrument is not necessary; its construction is shown in Fig. 257.

The Young evacuating cystoscopic lithotrite (Fig. 258) is also very practical.

The writer prefers a simple, strong lithotrite with a large evacuating lumen, and a simple, large examining cystoscope with a good lens. A combination of the two is only accomplished at the expense of both instruments. The writer performs litholapaxy under complete anesthesia and sees no reason why one instrument should not be withdrawn and another introduced.

CHAPTER II

THE USE OF THE HIGH FREQUENCY CURRENT IN LESIONS OF THE BLADDER

The effect of the high frequency current on diseased tissue has been variously employed by different operators. De Keating-Hart used it on the surface of an open wound from which all diseased tissue possible had been removed. The effect produced was both electric (an unknown quality) and mechanical, producing hyperemia of the parts. Edwin Beer first used the high frequency current (Oudin) in the treatment of bladder lesions. As used by him, the effect produced was by cauterization and electrolytic action. Others have used the current for the destruction of surface lesions, the result being obtained by *desiccation, which*, according to Clark, quoted by Uhle,* *means a devitalization by dehydration*, "rupturing the tissue cell capsule and transforming it into a dry mass." Tissue carbonization is produced by cauterization. *Desiccation is the effect most desired in treating papillomata* of the bladder.

As employed through the cystoscope or suprapubic wound, the high frequency current has been found to be useful in a number of urologic conditions, most important among which is new growth of the bladder.

THE TREATMENT OF NEW GROWTH OF THE BLADDER

We are indebted to Dr. Edwin Beer, of New York, for the development of this method of treating new growths of the bladder.

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* Uhle: "Annals of Surg.," vol. lx, p. 319.

Equipment.—Much naturally depends upon a proper outfit. Unfortunately, we have no standard by which the machines and their outputs can be definitely measured in units suitable for the establishment of a system of dosage. The variation in voltage, as compared with the amperage, found in different makes of machines will naturally affect the technic and the results. For example, one very capable operator began by using the d'Arsonval current and then changed to the Oudin current, and finds it far more efficacious in the treatment of bladder tumors. While, on the other hand, an equally careful operator started by using the Oudin current and later adopted the d'Arsonval current, and finds the latter much more efficacious than the Oudin in the treatment of all bladder tumors. These two operators use totally different types of machine, and it is my personal opinion that the so-called d'Arsonval current generated by the two machines is a different product, and therefore its effect must be different. Each operator must judge for himself. As for myself, I obtain the most constant results from the use of a "portable fulguration outfit," made for me by Wappler, of New York. At the same time I have a much larger high frequency apparatus, which is more suited for "thermo-penetration," but I prefer the portable outfit for high frequency bladder work.

The portable outfit is put up in two carrying cases, one containing the rotary converter, the other the step-up transformer, rheostat, spark-gap, etc.

On top of the rotary converter is a plate on which are mounted two metal pins marked "inlet." There is a cable connection with porcelain plug for connecting the apparatus with the street current. There is another cable on the side of the rotary, which is connected to the current inlet of the step-up transformer marked "75 volts." The right side of the inlet is marked "110 volts," and is used only when connecting directly to the alternating current, 110 volt circuit, without using the rotary converter. Besides the inlet pins there is a rheostat, the terminal for the Oudin current, two posts for the d'Arsonval current, and a spark-gap inclosed in a glass muffler. The apparatus is fitted with a suitable fuse plug. The foot switch may be used with the machine, and the proper terminals for its attachment are incorporated.

For use in producing the high frequency spark, Oudin current, the electrode is connected to the small, round, nickel-plated ball and the strength of the current is regulated by the rheostat and by the length of the spark in the glass muffler.

For using the d'Arsonval current there are two terminals, into each of which the connecting wires are plugged. One wire passes to a lead plate which is placed beneath the buttocks of the patient and is in contact with the skin. The second wire is attached to the electrode that is passed through the cystoscope in the bladder. The strength of the current is also regulated by the rheostat and the length of the spark in the glass muffler. The small glass muffler has to be taken off frequently, washed out, and dried thoroughly to prevent a deposit on the glass which would soon cause a leakage of the current. The bearings of the motor should be regularly oiled.

The electrode should preferably be a single copper wire properly insulated. Insulated steel wires are used by some, while others prefer small multiple copper wires properly insulated.

Beer thinks that the d'Arsonval current has much less cauterizing and electrolytic action than the Oudin current. This conclusion was based upon experimental work done by him. Oudin claims that the current which bears his name produces no electrolytic phenomena in the tissues. The writer believes that it is not the actual cauterization of the papillomata which is desired, but rather the degree of desiccation which is of value in the treatment of papillomata of the bladder, and he believes that the d'Arsonval current, properly applied, produces better effects than the Oudin.

In employing these currents in the bladder we use, in addition to the generator, a double catheterizing cystoscope with irrigating attachments; long copper or steel wire electrodes, properly insulated and small enough to pass through the catheter canals; proper devices to connect the wires with the generator. The current is controlled by a foot switch.

Before attempting to apply the treatment all the apparatus is adjusted and tested. If the operator is unfamiliar with his machine, he should make the proper electric connections, and, with the electrode attached to the single pole, should thoroughly study the effect of the current on a piece of raw meat, varying the spark gap and the rheostat, finally adjusting both of these so that he obtains the amount of tissue destruction which he desires *in a certain definite number of seconds.* The depth of penetration and the surface extent of the burn must both be carefully noted, because *the same effect will be produced in the bladder.* (See Fig. 260.)

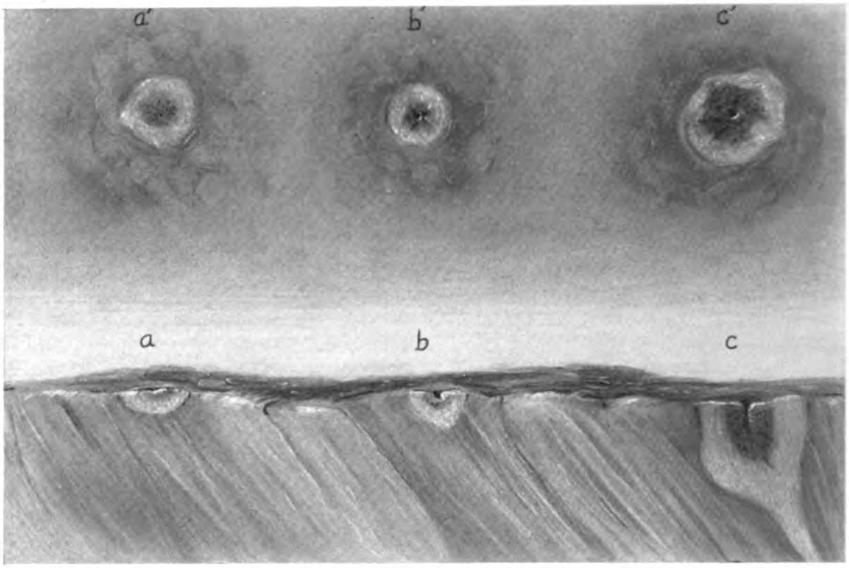

Fig. 260.—Surface appearance and a cross-section view of a piece of meat which has been exposed to the action of the high frequency spark under varying conditions.

a is a cross-section view of the effect of the d'Arsonval spark applied for fifteen seconds with electrode $\frac{1}{8}$ inch from the surface of the meat. It will be seen that the baking has extended to about an equal distance below the surface of the meat and that there is no real tissue destruction.

a' is a surface view of the same exposure showing the width over which the spark was effective.

b shows the effect of the Oudin current with electrode in contact with the meat, applied with the same spark gap as *a* and for the same length of time. It will be seen that the baking penetrates deeper, that there is a central charred area which means total destruction of tissue, and demonstrates very well the distance the effect of the spark extends beyond the point of contact.

b' shows the surface appearance of the same lesion.

c is a cross-section showing the effect of a strong application of the d'Arsonval current with the electrode thrust into the meat for about $\frac{1}{16}$ inch. This shows the depth of penetration of the current when applied for thirty seconds. It shows the central area of destruction and the surrounding area of desiccation. It also shows a peninsular of tissue extending more deeply into the meat along the muscle planes. We must always realize that the current may be unequal in its distribution.

c' shows the surface effect of the same. This is about the strength of current used in the treatment of cancer of the bladder after removal of the main cancer mass by the actual cautery. The inner blackened core becomes as hard as cartilage.

It is important to note that a totally different effect is produced when the wire electrode is in contact with the tissue itself, *i. e.*, the depth of penetration is much greater than when the spark is allowed to jump through space (air or water). (See Fig. 260, *b.*)

Adjusting the Spark Gap.—This is a matter of personal judgment. For example, Burton Harris uses the Oudin current with a very short spark gap, and little or no resistance on the rheostat, for in his experience it has seemed that the current was more destructive, less painful, and naturally showed less tendency to short circuit when used in this way. Certainly his excellent results would justify this formula *when used by him.* Another operator of wide experience uses the d'Arsonval current with a relatively large spark gap, and has had equally good results. Unquestionably the personal equation plays a most important part in this type of therapy.

Length of application depends on strength of current, tolerance of patient, character of growth, etc. We wish to dry up and destroy by heat the tumor tissue. *It is not necessary to carry the application to the point of tissue destruction.* In fact, this is what causes the unnecessary hemorrhage which is occasionally seen. The preliminary experiments with a piece of meat will enable the operator to establish an exact formula in a given case, *i. e.*, with the rheostat set at a given point, with a certain length of spark gap, with the electrode in contact with the object, the tissue will be thoroughly baked to a certain depth in a certain definite number of seconds. (See Fig. 260.)

Technic in Detail.—Always operate if possible in a clear liquid medium and with a brilliant illumination.

Local anesthesia of the bladder is seldom necessary. Morphin-hyoscin by hypodermatic injection, or a suppository of hyoscyamus and opium, is greatly appreciated by the patient, and retards spasm of the bladder.

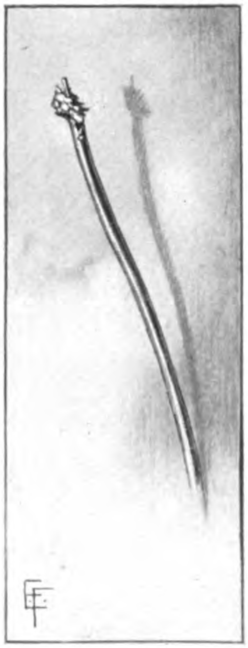

Fig. 261.—Showing condition of the distal terminal of electrode after a strong current has been applied with electrode in contact with the growth. The rubber insulation has been melted off and baked portions of the growth become attached to the electrode.

After the apparatus has been connected and tested a cystoscope, preferably provided with two catheter canals, is introduced.

The bladder is thoroughly cleansed and filled with warm water. The ends of the wire electrodes should be exposed for about 2 mm. The electrodes are then passed through the catheter canals until their distal ends appear in the bladder. One is then partly withdrawn into the sheath, to be used later if the insulation of the first wire becomes stripped up or the tip of the wire becomes too foul by adhesion of the desiccated tissue to the electrode (Fig. 262). This first wire is then advanced (Fig. 263) and guided by the deflector, the end of the wire is engaged in the growth *as near its base as practicable* (Fig. 263). Then the current is turned on and continued for the given period which has been decided on before the wire was introduced. The point of impact of the wire and growth will show the production of a stream of gas-bubbles, and later detritus, but it should not excite much hemorrhage.

If hemorrhage does occur, the wire should be withdrawn a little and the new spark will probably control it. If the patient complains of pain when the current is turned on, it signifies that the effect of the current has reached beyond the growth and is destroying normal tissue. The electrode should then be withdrawn and reapplied. Pain will also be produced by a short circuit anywhere within the body.

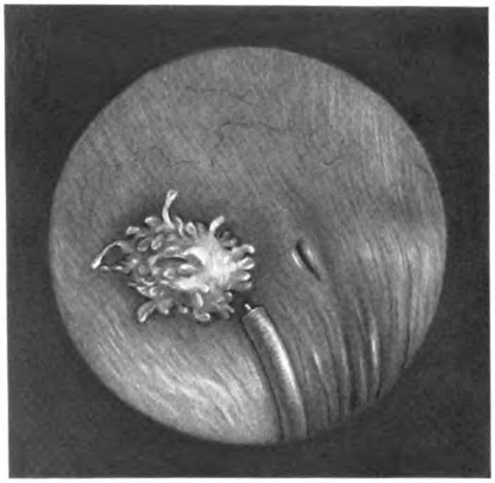

Fig. 262.—Cystoscopic picture showing the electrode approaching the papilloma.

The Number of Applications at One Sitting.—The operator must use his own judgment in each individual case. No toxic effect will result from the destruction of multitudinous papillomatous growths within the bladder. Harm might result from the overcauterization of an extensive tumor base. Try not to tire the patient too much at the first séance. The less formidable the first treatment is, the more ready the patient will be to return for another.

Number of treatments vary from 1 to 30 or more. The treatment may be safely continued as long as improvement, both general and local, subjective and objective, is noticed.

Interval Between Treatments.—Once a week seems sufficient while treating the villous or papillomatous part of any growth. When the base is reached, we should not apply the current so frequently, for an edematous swelling follows the application of the spark to the base and often the necessity of further treatment cannot be estimated for three or four weeks.

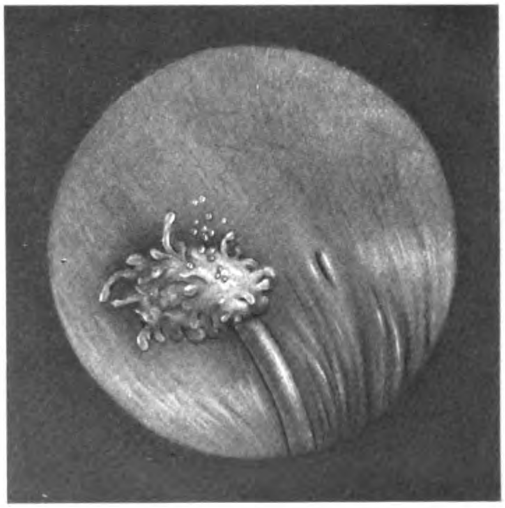

Fig. 263.—Cystoscopic picture showing the electrode engaged in the growth and the current turned on. Note that the electrode engages the growth as near its base as possible, and that there are bubbles of gas arising from the growth.

Evidence of Cure.—A bladder which has once been the seat of a new growth should always remain under suspicion. At first, after disappearance of a growth, the bladder should be examined at intervals of two months, four months, six months, and every year thereafter.

Difficulties Encountered.—There should be no difficulty with the current itself and the electric apparatus. It is difficult, however, to obtain good wires well insulated. The single copper wire with insulation of rubber is the best for my use. The supply of this should be constantly renewed, because after using once or twice it becomes sticky, kinks easily, and is therefore difficult to manipulate and advance properly through the catheter canals. *Ease of manipulation is very essential to success in these cases.* Therefore use new clean wire well lubricated. Melting of the insulation is another trying factor. After the current has been applied for a certain time with the electrode in contact with the growth the rubber will melt off and leave the electrode bare, so that the current does not properly enter the

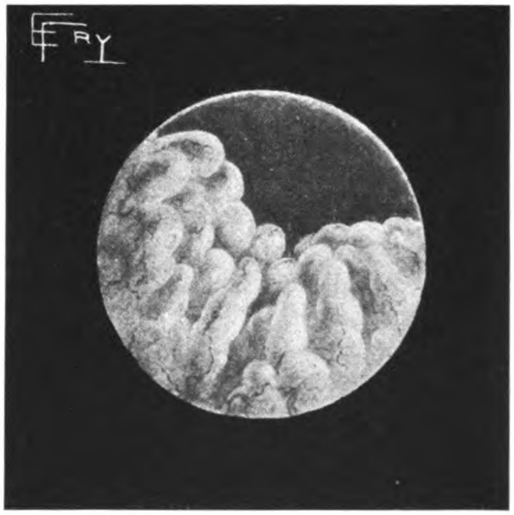

Fig. 264.—Cystoscopic appearance of a large papilloma filling the bladder. An actual drawing showing the finger-like projections crowding against the lens of the cystoscope. This growth was entirely destroyed by three applications of the Oudin current.

tumor. The only way to obviate this is to use less current and renew the wire. At this point the wire in the other catheter canal is advanced and used.

Short circuiting can be prevented by proper insulation of chair, table, operator, and patient. Shut off the current, if a short circuit occurs, and shorten the spark gap.

Clouding of the Medium.—If constant irrigation does not give one a fairly clear view of the electrode and growth, it is better to wait for a more favorable time before applying the treatment. Sometimes, however, the villous growths entirely fill the bladder (Fig. 264). Then one is justified in advancing the electrode blindly into the mass and turning on the current, stopping if pain is complained of. In one case which I treated I used this blind method for three

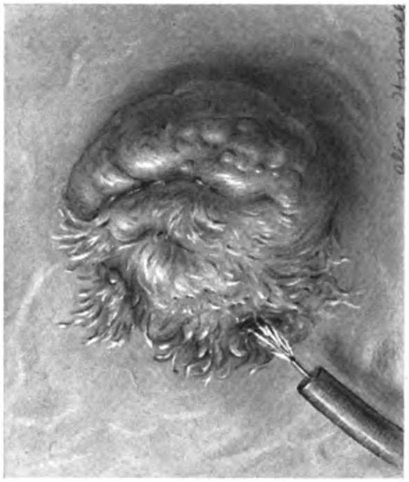

Fig. 265.—A combined villous and bald carcinoma of the bladder with bleeding point, showing the method of interposing a spark gap between the end of the electrode and the bleeding surface. This applies to any superficial ulcer which is bleeding within the bladder.

or four treatments before it was possible to see the relative position of the growth.

If severe hemorrhage should occur, the bleeding point should be found, if possible, and cauterized by using the d'Arsonval current applied with the end of the electrode about 2 mm. from the bleeding point (Fig. 265).

Contraindications for Use of High Frequency Spark.—Contraindicated in case of:

1. Extensive cancerous growths with infiltrated base (Fig. 266).
2. In tumors that bleed excessively when the cystoscope is introduced.

Indications for Treatment.—The use of the high frequency current, either generated by the d'Arsonval or the Oudin current, *is indicated in every case of papillomatous growth in the bladder.* It should always be tried before operation is resorted to. It is our belief that most of the multiple papillomatous growths of the bladder are actively or potentially malignant. We know that many of these growths have entirely disappeared when treated by high frequency current. The effect of the current as usually applied to an infiltrating carcinoma is usually negative. *In small recurrent cancers of the bladder* it has been the experience of the writer that some of these recurrences can be entirely destroyed in the following way: The patient is given a general anesthetic, the bladder carefully distended with water, and the growth subjected to a strong high frequency spark (d'Arsonval) of deep penetration. In one case this treatment was applied twice within a week to a small recurrent growth of the bladder which appeared about eight months after an intraperitoneal removal of an extensive infiltrating cancer of the bladder, and the patient still enjoys good health after a period of a year, without visible signs of recurrence or evidences of metastases.

In other words, *treatment through the cystoscope should be applied only to the papillomatous tumors of the bladder and the early recurrent cancers*, and not to the primary infiltrating cancers.

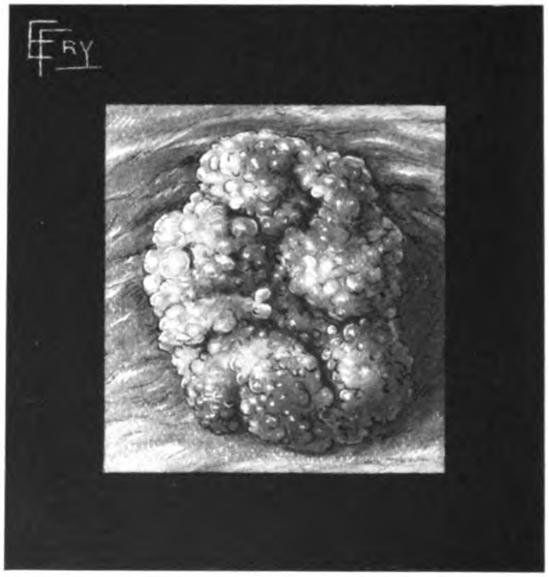

Fig. 266.—Cystoscopic appearance of a cancer of the bladder. Actual case in which high frequency spark treatment through cystoscope is useless. The mass is only a superficial expression of a deeply infiltrating cancer. Suprapubic operation with the cautery and then applying the d'Arsonval current is indicated.

CONTROL OF HEMORRHAGE

Next in point of effectiveness the high frequency current is useful in the control of hemorrhage at any point, but especially within the bladder, where it may be applied through the cystoscope. Here the method of application is somewhat different. The point of bleeding, if superficial, is carefully exposed, the generator adjusted with a fairly long spark gap, but with only one or two points of resistance. As the electrode approaches the bleeding point, and when it comes within about ⅛ inch of the objective point, the current is turned on. If the spark reaches from the electrode to the bleeding point, the current is allowed to flow for two or three minutes, the electrode being directed so that its effect will be distributed over the area immediately surrounding the bleeding point (Fig. 265). It is really in this surrounding zone that the current acts most effectively in stopping the hemorrhage, in that it closes the blood-vessels in the healthy tissue supplying the bleeding

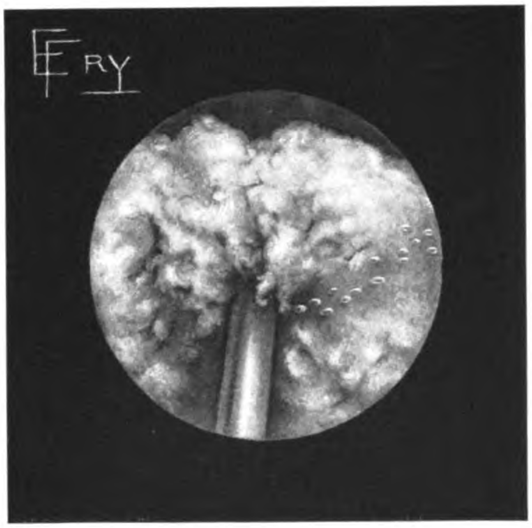

Fig. 267.—Cystoscopic picture from an actual case where the electrode has been deeply thrust into soft, pultaceous material covering the new growth of the bladder in an effort to stop a deep-seated hemorrhage. When bubbles are seen, as in the picture, we know that the current is acting upon the tissue, although no spark is seen.

zone. If the hemorrhage cannot be controlled in this way, the electrode is then brought directly in contact with the bleeding point (Fig. 267), the spark gap on the generator is shortened, more resistance is introduced, and the current is applied for about thirty seconds and repeated until the bleeding stops.

In those cases where the bleeding is concealed and is coming from a papilloma or necrotic area of cancer, control can be obtained only by burning away the superficial portions of the growth and then introducing the electrode into the base, applying a strong current blindly. By this means the writer has been able to control hemorrhage within the bladder, in a few desperate cases in which the older methods have failed, and has lessened the bleeding and finally stopped it in many cases of papilloma.

The effect of this current may be beautifully demonstrated on bleeding areas and growths which are exposed to direct vision, such as those affecting the skin, cervix, tongue, etc.

THE TREATMENT OF CHRONIC ULCERATION

Varying degrees of chronic ulceration are met with in the bladder, including *the chronic solitary ulcer* of unknown origin, *the tubercular ulcer, the unhealed ulcer developing as a tissue defect* following operation on the bladder-wall, and other forms as yet unclassified. The experience of a number of operators leaves us without any definite means of determining which ulcers will be healed by the high frequency spark and which will not. In my own experience I have found that the Oudin spark is not nearly as effective as the d'Arsonval spark in these cases; and, again, that the best effect is produced when a penetrating, strong spark is applied to the chronic ulcer across an *air space* of about $\frac{1}{8}$ inch. This may well be shown in the treatment of an actual case where a malignant growth developed on an old chronic ulcer base.

Case Report.—A girl twenty years of age who was referred to us from Astoria. Three years ago she had been operated upon in New York for multiple papillomata of the bladder through the suprapubic cystotomy wound. Two years later there was a recurrence of the growth on the base of a large ulcer which refused to heal. This was curetted. Three weeks after the operation blood appeared in the urine. Six months later she was admitted to our clinic and a cystoscopic examination showed a fungoid-like growth covering a considerable area of the posterior wall of the bladder, overlapping the trigone. Dr. Osgood, of New York, who saw the case originally, informed us that the larger growth was

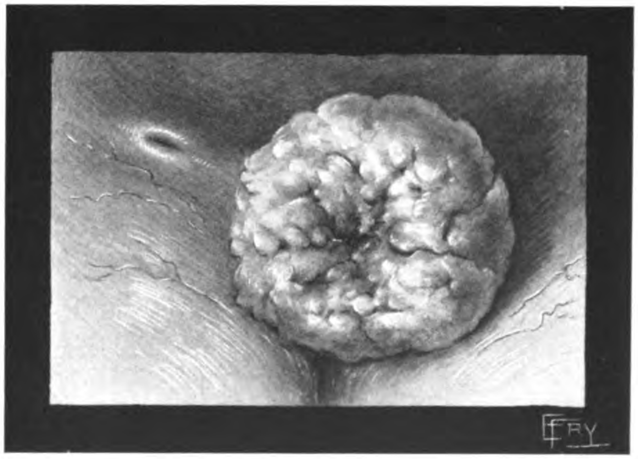

Fig. 268.—Superficial appearance of new growth springing from a chronic ulcer base in an early stage, as seen in the case reported. The growth was almost twice this size before operation was undertaken.

springing from an ulcer which refused to heal after the original operation. In other words, the ulcer had been present for two years. There were other spots of involvement on the posterior wall of the bladder. An attempt was made to destroy the larger fungating mass on the surface of the ulcer by the Oudin current, but this was unsuccessful. The superficial appearance of the growth is shown in Fig. 268, which is an actual drawing made by Miss Eleanor Fry. The condition evidently was malignant. *The patient was failing rapidly and losing a great deal of blood* and suffering much pain.

Operation.—The bladder was opened above the pubis, the trigone and posterior wall of the bladder were easily exposed, and the necrotic exuberant tissue on the surface of the ulcer was curetted away and the base of the entire growth was exposed to the bipolar high frequency spark, which had a penetration of ¼ inch. There were numerous daughter growths on the posterior wall of the bladder and these were treated in the same way. The bladder was drained. In six weeks the suprapubic wound healed, and cystoscopic *examination showed the entire surface of the bladder to be healed.* One year and a half have passed since that time and repeated examinations show the bladder to be entirely healed; there is no evidence of recurrence, and there are no symptoms of any urinary disorder.

THE TREATMENT OF MASSES OF TISSUE WHICH CAUSE OBSTRUCTION

In the removal of obstructions to the passage of urine the high frequency current is useful in two ways: First, in the treatment of strictures by electric dilatation, and, second, in the destruction of the obstructing mass by desiccation.

1. **Treatment of Strictures.**—It has been shown that

the tissue composing a stricture of inflammatory origin can be softened and, therefore, made more pliable and dilatable by the application of the d'Arsonval current applied directly to the constricting tissue through the medium of metal olivary tips which are attached to an electrode. Buerger has devised a serviceable series of these olives (see Fig. 269), and by their use has succeeded in dilating constrictions of the ureter behind which calculi were lodged. His technic is as follows:

"Detachable metal olives (Fig. 269) are screwed on the end of an insulated wire electrode. These can be introduced into the lower end of the ureter, after the fashion of a ureteral catheter. With a large indifferent electrode over the symphysis or lower abdomen, the second pole being the metal olive, a current of 200 to 400 milliamperes is allowed to pass, while gentle pressure is exerted against the point of ureteral obstruction. In many cases we will be surprised to see the obstruction give way after a few seconds of contact. The olive is then removed and a larger one inserted, the process being repeated until the ureter is dilated to No. 12–18 Fr. or more.

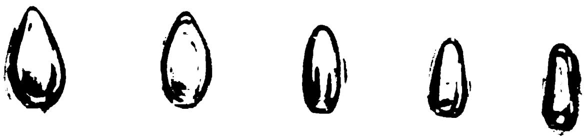

Fig. 269.—Olivary tips for dilating small strictures by aid of high frequency current (Buerger).

"This method has been found valuable in many cases where forcible dilatation with bougies had failed. In a number of cases of descending ureteral calculi where this procedure was carried out a small stone lodged in the lower part of the ureter was passed shortly after dilatation had been performed.

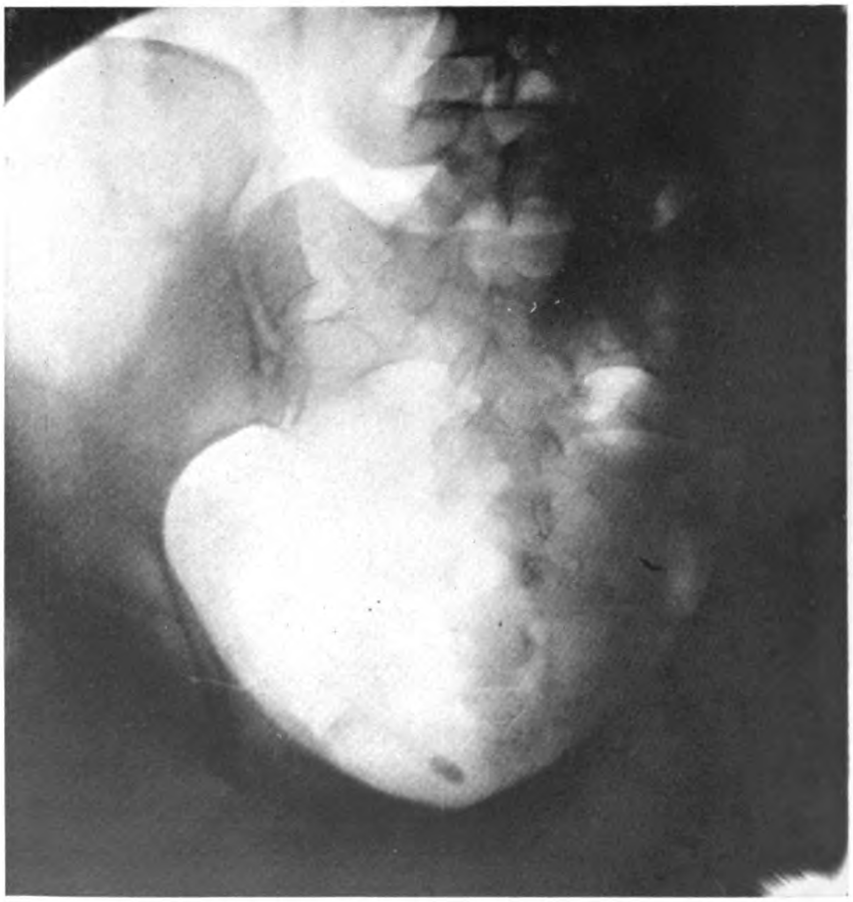

Fig. 270.—Showing the size of the stone contained in the lower ureter corresponding to Fig. 271. The detail of the bony structures is sacrificed in order to bring out the stone more prominently.

"In some cases it is useful to leave the olivary dilator *in situ* for ten minutes or more, or until colicky pain ensues. For this purpose the large electric coupling may be detached and the electrode left in place" (Buerger).

This method depends upon the softening effect of the current on the stiff infiltrated tissue. The current produces heat at the point of contact, without any desiccation or cauterization.

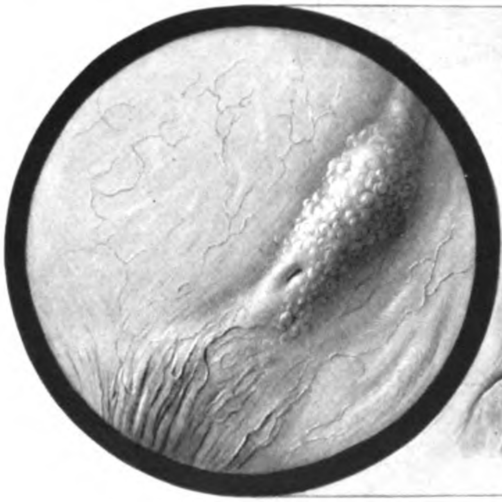

Fig. 271.—Cystoscopic picture of stone in the vesical portion of the left ureter. Same case as Fig. 270.

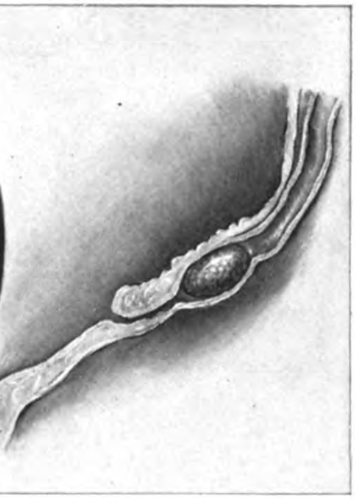

Fig. 272. — Cross-section showing stone impacted in vesical portion of left ureter.

2. **Treatment of Obstructions.**—In short, the usefulness of the spark depends upon its capacity for destroying the obstructing tissue. It has been used by the writer in only two conditions, *i. e.*, calculus impacted in the vesical portion of the ureter and in obstructive prostatic disease.

A. *Calculus Impacted in Vesical Portion of the Ureter.*—The experience of the writer is as follows: A calculus was descending the left ureter and became impacted in the vesical portion of the same. Efforts were made to extract the stone, but all efforts to dilate the orifice sufficiently were unsuccessful. The ureter containing the stone caused edema of that portion of the bladder immediately surrounding it, so that it appeared as a tumefaction in the bladder. It was decided to attempt destruction of the tissue lying between the calculus and the interior of the bladder. For this purpose the Oudin spark was applied directly to the tissue overlying the stone. Two days later the stone was still in place. On the fourth day the bladder was opened, and it was found that the tissue had sloughed away, leaving a sufficient opening into the ureter and the stone had dropped out into the bladder. The patient has been entirely well ever since. To our mind this was a very satisfactory outcome. Previous to the application of the spark all the other

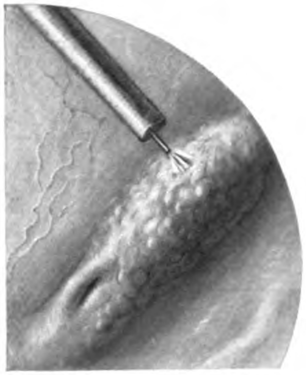

Fig. 273.—Shows method of applying the high frequency current to the tissue overlying the stone impacted in the ureter.

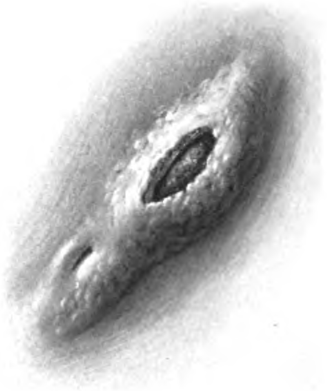

Fig. 274.—Shows resulting opening in the wall of the ureter through which a stone was discharged into the bladder. Actual case.

aids had been employed, including the dilators, forceps, cutting instruments, etc.

B. *Obstructive Prostatic Disease.*—The effectiveness of this method of treatment has not as yet been sufficiently proved. It is conceded, however, that nearly every case can be improved, but few cases cured by the use of the spark. It is most useful in the malignant cases and in the cases of small fibrous prostates and median bar cases. The same instruments are used as for other forms of desiccation. The bladder is anesthetized by novocain. The effect of the current should be tested on meat before applying, As a rule, the length of each application is about one minute: the number of applications at each sitting depends upon the individual case. It requires about ten days for the tissue from a single burning to come away.* The treatments may be continued until the mass of obstructive tissue has been destroyed.

TECHNIC OF APPLYING HIGH FREQUENCY SPARK IN PROSTATIC DISEASE

The most extensive work in this department has been done by Dr. Henry G. Bugbee, of New York, whose technic we have adopted. The technic is as follows:

A No. 18 indirect, close vision cystoscope is used because this instrument gives a better view of the vesical neck and is easier to manipulate in that location. The instrument is introduced into the bladder and a wire electrode, No. 5 French, is passed through the catheter canal into the bladder. The electrode is then held firmly against the bar or the median lobe, and after all the proper adjustments have been made, the current is turned on. The strength of the current should be sufficient to give a half-inch spark. Holding the electrode against the tissue to be destroyed, the cystoscope is slowly withdrawn so that the spark is applied along a line which crosses the obstructing bar, and results in producing a cleft. This is all that is done at the first application. One week later a second treatment is given, making the application in the same manner, creating a cleft by the destruction of tissue parallel to the one made at the previous treatment. After ten days or two weeks the tissue between the two clefts is destroyed by an application of the spark directly to it. The treatment may have to be repeated several times at varying intervals, depending upon the tolerance of the patient and the amount of reaction. In the ideal case there is not much discomfort during or following the treatment. Inflammatory conditions involving the neck of the bladder increase the pain of the treatment, and it may be necessary to treat the bladder to allay the inflammation.

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* Bugbee: "Medical Record," February 14, 1914.

For anesthesia of the bladder a 4 per cent. novocain solution, to which some adrenalin has been added, is introduced into the bladder and left there for fifteen or twenty minutes before the treatment is begun. This method of treatment, while in no way replacing the operative methods of removing the obstruction, still offers some benefit under the following conditions:

1. Cases of median bar obstruction.
2. Fibrous contractions of the neck of the bladder.
3. Small ball-valve median lobe enlargements of the prostate.

4. As a palliative treatment in those cases where complete operative treatment is not possible.

5. For the relief of obstruction in cases of carcinoma.

In summing up this chapter on the uses of the high frequency current the writer would like to emphasize the fact that this agent is not simply a toy, for use as a palliative measure. It is a powerful agent when properly employed, and it is our feeling that the limit of its usefulness has not yet been reached. It offers us more hope in the treatment of tumors of the bladder than any previously devised method of treatment.

APPENDIX

SOME USEFUL SPECIAL CYSTOSCOPES

We present illustrations of two new styles of instruments which are useful especially for observation in persons with small urethrae and for various applications at the neck of the bladder and in the urethra.

Fig. 275 is a Wappler instrument, No. 18 French, with the fenestra on the convex surface of the elbow, fitted with a correct view close vision lens, and can be used to explore the urethra as well as the neck of the bladder. It contains a single catheter canal, and it is especially useful in applying the high frequency spark to an enlarged prostate.

Fig. 276 is a similar instrument, with the fenestra on the convex surface of the elbow, and useful more especially for the treatment of lesions at the neck of the bladder.

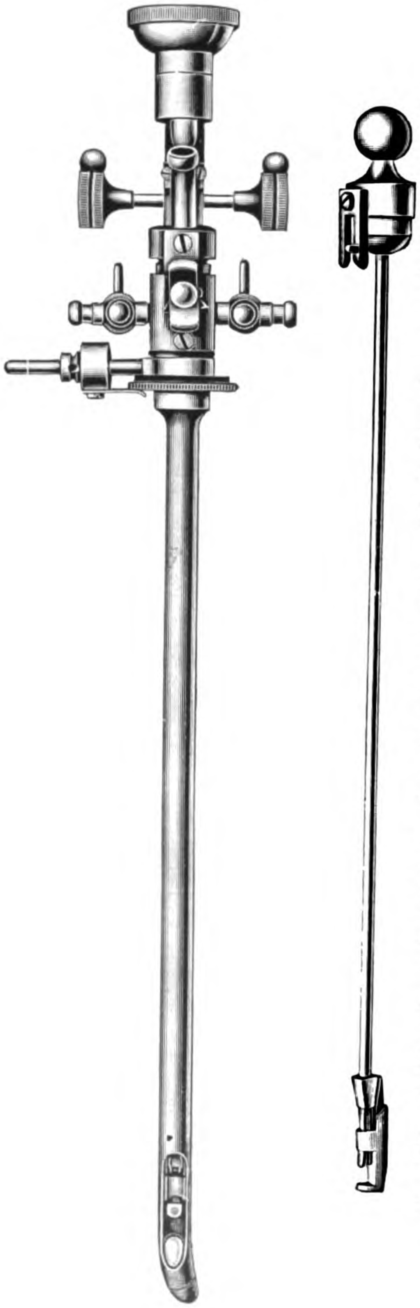

Fig. 275.—A Wappler catheterizing and treatment cystoscope with single catheter canal, No. 18 French.

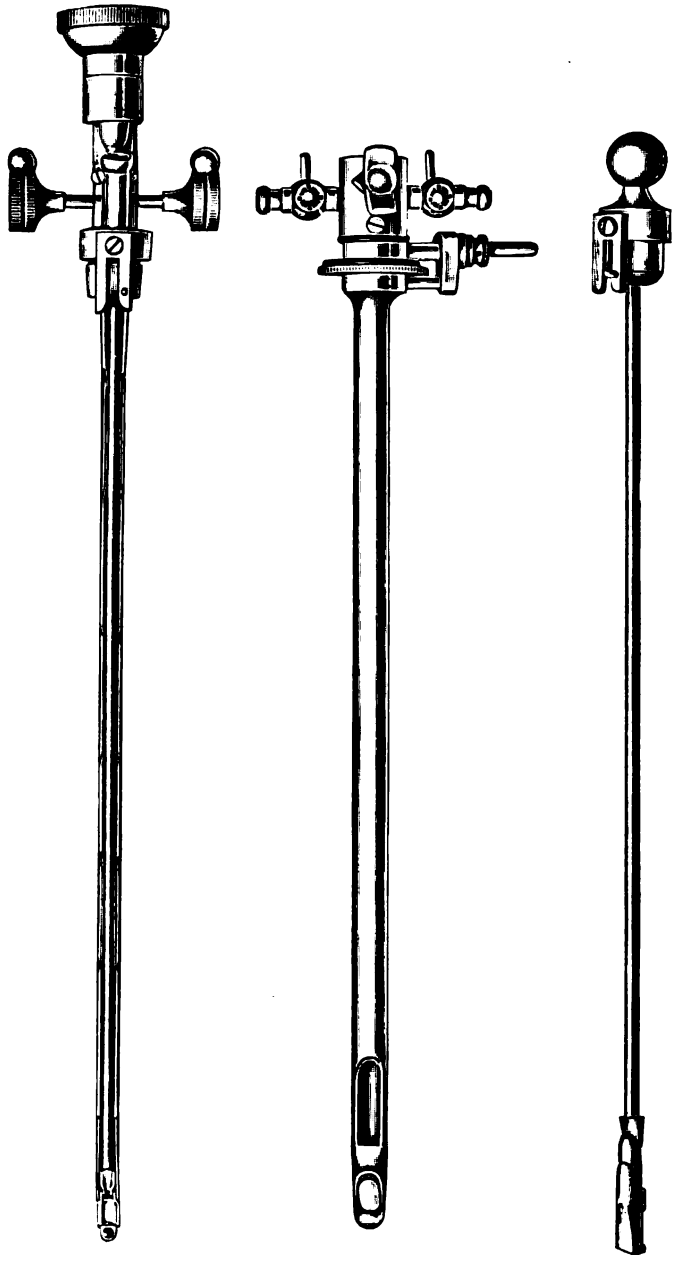

Fig. 276.—A Wappler catheterizing and treatment cystoscope of small caliber, as described in text.

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